11-5820-805-14

TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT

MAINTENANCE MANUAL

RECEIVER, RADIO AN/GRR-23
FSN 5820-123-3937

AND

RECEIVER, RADIO AN/GRR-24
FSN 5820-123-3945

This copy is a reprint which includes current pages from Changes 1 and 2.

HEADQUARTERS, DEPARTMENT OF THE ARMY
JUNE 1973

D 101.11:

READEX FICHE best copy available

WARNING

DANGEROUSLY HIGH VOLTAGES EXIST IN THIS EQUIPMENT
DEATH OR SERIOUS INJURY
CAN RESULT FROM CONTACT WITH THESE VOLTAGES

WARNING

Remove all jewelry. Use insulated screwdrivers. Be extremely careful when working on equipment. Observe all warnings and instructions concerning application of power

CHANGE
No. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC, *6 November 1980*

Operator's, Organizational, Direct Support, and General Support Maintenance Manual
RECEIVER, RADIO AN/GRR-23 (NSN 5820-00-123-3937)
AND
RECEIVER, RADIO AN/GRR-24 (NSN 5820-00-123-3945)

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NO. 1

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OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL RECEIVER, RADIO AN/GRR-23 (NSN 5820-00-123-3937) AND RECEIVER, RADIO AN/GRR-24 (NSN 5820-00-123-3945)

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6-1 through 6-8	6-1 through 6-8
6-15 through 6-17	6-15 through 6-17 (6-18 blank)
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FO-1 through FO-8	FO-1 through FO-8
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To be distributed in accordance with DA Form 12-51, operator maintenance requirements for AN/GRR-23 and AN/GRR-24.

TECHNICAL MANUAL
No. 11-5820-805-14

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 25 June 1973

Operator's, Organizational, Direct Support, and

General Support Maintenance Manual

RECEIVER, RADIO AN/GRR-23 (NSN 5820-00-123-3937) AND

RECEIVER, RADIO AN/GRR-24 (NSN 5820-00-123-3945)

			Paragraph	Page
CHAPTER 1.		INTRODUCTION		
Section	I.	General	1-1—1-5	1-1
	II.	Description and data	1-6—1-12	1-1
CHAPTER 2.		SERVICE UPON RECEIPT AND INSTALLATION		
Section	I.	General	2-1—2-3	2-1
	II.	Installation instructions	2-4—2-7	2-1
	III.	Preliminary checks and tuneup procedure	2-8—2-12	2-9
CHAPTER 3.		OPERATING INSTRUCTIONS		
Section	I.	Controls and instruments	3-1, 3-2	3-1
	II.	Operation under usual conditions	3-3—3-5	3-5
	III.	Operation under unusual conditions	3-6—3-8	3-5
CHAPTER 4.		OPERATOR AND ORGANIZATIONAL MAINTENANCE INSTRUCTIONS		
Section	I.	General	4-1—4-4	4-1
	II.	Organizational preventive maintenance	4-5, 4-6	4-1
	III.	Organizational troubleshooting of VHF and UHF receivers	4-7, 4-8	4-3
	IV.	Organizational maintenance of VHF and UHF receivers	4-9—4-11	4-4
CHAPTER 5.		FUNCTIONING OF EQUIPMENT		
Section	I.	Block diagram explanation	5-1, 5-2	5-1
	II.	Schematic explanation of circuits	5-3—5-17	5-2
CHAPTER 6.		DIRECT SUPPORT MAINTENANCE INSTRUCTIONS		
Section	I.	General	6-1, 6-2	6-1
	II.	Direct support troubleshooting	6-3—6-6	6-1
	III.	DS maintenance of Receiver, Radio AN/GRR-23 and Receiver, Radio AN/GRR-24	6-7—6-17	6-10
	IV.	Alignment and performance test of VHF and UHF receivers	6-18, 6-19	6-15
CHAPTER 7.		GENERAL SUPPORT MAINTENANCE INSTRUCTIONS		
Section	I.	General and troubleshooting	7-1—7-4	7-1
	II.	GS maintenance of VHF and UHF receivers	7-5—7-15	7-4
APPENDIX A.		REFERENCES		A-1
	B.	MAINTENANCE ALLOCATION		B-1
Index				I-1

LIST OF ILLUSTRATIONS

Figure No.	Title	Page
1-1	Receiver, Radio AN/GRR-23 with interface cable kit and less running spares	iv
2-1	VHF/UHF receiver, outline dimension drawing	2-2
2-2	Typical view of MT-686/GR rack mounting (right side)	2-3
2-3	Mounting brackets, dimension drawing	2-4
2-4	Angle supports for use with CY-597/G cabinet installation, dimension drawing	2-5
2-5	DELETED	
2-6	Connection for two VHF or UHF receivers operating from common antenna	2-6
2-7	VHF receiver, interconnecting cable length vs frequency	2-7
2-8	UHF receiver, interconnecting cable length vs frequency	2-7
2-9	Strapping arrangement for input power transformer terminal board (PS1TB1) on VHF/UHF receivers	2-7
2-10	VHF receiver tunable filter (FL2), turns of C1 and C2 vs frequency	2-9
2-11	UHF receiver tunable filter (FL2), turns of C1 and C2 vs frequency	2-12
3-1	Receiver, Radio AN/GRR-23, front panel controls and indicators (identical on AN/GRR-24)	3-1
3-2	Receiver, Radio AN/GRR-23, controls and indicators behind front panel access door (for difference between AN/GRR-23 and AN/GRR-24, see table 3-1)	3-2
3-3	Receiver, Radio AN/GRR-23, test points on front panel access door (identical on AN/GRR-24)	3-3
3-4	Receiver, Radio AN/GRR-23 rear panel connectors (identical on AN/GRR-24)	3-3
5-1	VHF/UHF receiver, functional block diagram	5-2
5-2	VHF/UHF receiver oscillator module (A1), schematic diagram	5-4
5-3	VHF/UHF receiver buffer amplifier (A5), schematic diagram	5-6
6-1	VHF/UHF receiver, top view, parts location and identification	6-11
7-1	VHF/UHF receiver, rear top view, chassis component parts location and identification	7-5
7-2	VHF/UHF receiver, chassis component parts on divider wall and rear panel, left oblique view	7-6
7-3	VHF/UHF receiver, chassis component parts on divider wall and rear panel, right oblique view	7-7
FO-1	VHF receiver mixer multiplier module (A2), schematic diagram	Fold-in
FO-2	UHF receiver mixer multiplier module (A2), schematic diagram	Fold-in
FO-3	VHF/UHF receiver optional noise limiter (A5), schematic diagram	Fold-in
FO-4	VHF/UHF receiver intermediate frequency amplifier and detector (A6), schematic diagram	Fold-in
FO-5	VHF/UHF receiver preamplifier/age-squelch (A3), schematic diagram	Fold-in
FO-6	VHF/UHF receiver audiofrequency amplifier (A4), schematic diagram	Fold-in
FO-7	VHF/UHF receiver power supply (PS1), schematic diagram	Fold-in
FO-8	VHF/UHF receiver, overall schematic diagram	Fold-in

LIST OF TABLES

Table No.	Title	Page
1-1	Items Comprising an Operable Equipment	2-2
2-1	Crystal Oscillator Frequency Determination	2-8
2-2	VHF Receiver Multiplier Injection Voltage Levels	2-10
2-3	UHF Receiver Multiplier Injection Voltage Levels	2-13
3-1	Controls and Indicators	3-4
4-1	Operator/Crew Preventive Maintenance Checks and Services	4-2
4-2	Organizational Preventive Maintenance Checks and Services	4-2
4-3	Organizational Troubleshooting of VHF/UHF Receiver	4-3
4-4	Organizational Test Point Readings	4-4
6-1	VHF/UHF Receiver Fault Localization Indications	6-2
6-2	Normal Front Panel Test Point Indications	6-3
6-3	Fault Isolation Using Test Point Indications	6-5
6-4	Further Troubleshooting Procedures	6-6
6-5	Power Supply Fault Analysis	6-7
6-6	Rf Circuits Fault Analysis	6-9
6-7	Noise Limiter/Buffer Amplifier (A5) Output Fault Analysis	6-10
6-8	If. Amplifier (A6) and Crystal Filter (FL1) Fault Analysis	6-10
6-9	Performance Test of VHF and UHF Receivers	6-15
7-1	VHF/UHF Receiver Wire List	7-2

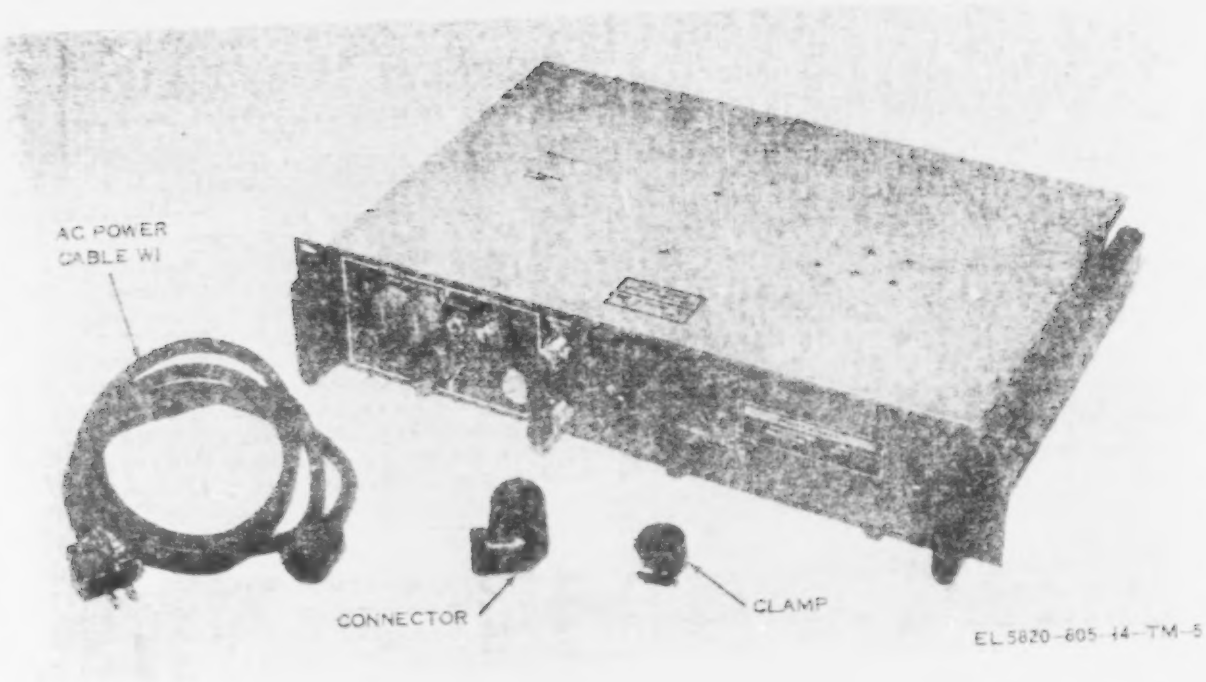


Figure 1-1. Receiver, Radio AN/GRR-23 with interface cable kit, less running spares.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope

a. This manual contains information concerning Receiver, Radio AN/GRR-23 (fig. 1-1) and Receiver, Radio AN/GRR-24, including the following instructions:

(1) Installation.
(2) Operation.
(3) Organizational maintenance.
(4) Direct support maintenance and repair.
(5) General Support maintenance and repair.

b. Air traffic controllers or control tower operators will normally be the personnel operating the receiver, and will have no allocated maintenance duties. Organizational personnel will perform simple maintenance duties, such as fuse and lamp replacement which are normally allocated to the operator.

c. Depot maintenance duties will be performed by the US Air Force in accordance with Wholesale Interservice Supply Support Agreement, agent's acceptance number (Air Force) OC-69-011, and principal's request number (Army) A256561037. Army personnel should forward to the cognizant Air Force activity any unserviceable modules or end items which cannot be repaired by general support or below as provided for in the maintenance allocation chart in appendix B. Replacement modules or end items will be requisitioned through normal Army channels.

1-1.1. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

1-2. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR 71-13/MCO P4030.29A, and DSAR 4145.8.

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33A/AFR 75-18/MCO P4610.19B, and DSAR 4500.15.

1-3. Destruction of Army Materiel to Prevent Enemy Use

Refer to TM 750-244-2 for requirements and procedures for the destruction of electronic equipment to prevent enemy use.

1-4. Administrative Storage

Requirements and procedures for administrative storage will be in accordance with TM 740-90-1.

1-5. Reporting of Errors

The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded direct to Commander, US Army Electronics Command, ATTN: DRSEL-MA-Q, Fort Monmouth, NJ 07703.

Section II. DESCRIPTION AND DATA

1-6. Purpose and Use

Receiver, Radio AN/GRR-23 and Receiver, Radio AN/GRR-24 are designed for worldwide deployment in air traffic control service and provide reception for air-to-ground and point-to-point voice communication in the amplitude modulated (am.) mode and in the very high frequency (vhf) bands, and ultrahigh frequency (uhf) respectively. They are designed to perform reliably in an air traffic control environment.

1-7. Description

(fig. 1-1)

a. Receiver, Radio AN/GRR-23 is commonly referred to throughout this manual as the *VHF receiver.* Receiver, Radio AN/GRR-24 is commonly referred to throughout this manual as the *UHF receiver.* When the term receiver is used, it refers to both or either of the VHF and UHF receivers. AN/GRR-23 is unit 1 and AN/GRR-24 is unit 2 and

all reference designations will be preceded initially by a 1 or 2 as applicable. The remainder of the reference designation shall follow.

b. The VHF receiver is a single-channel, superheterodyne type operating in the am. mode. It is capable of receiving on any one of 680 channels spaced 50 kiloHertz (kHz) apart between 116.00 megaHertz (MHz) and 149.95 MHz (vhf). By exchanging certain of the frequency determining modules with their corresponding uhf modules, the VHF receiver can be converted to the UHF receiver which provides receiving capability on any one of 3500 channels spaced 50 kHz apart between 225.00 MHz and 399.95 MHz (uhf). See paragraph 1-8 for details of conversion from vhf to uhf and uhf to vhf. Both receivers are solid-state and are equipped with their own integral power supply requiring an alternating current (ac) line voltage as specified in paragraph 1-11. Provision is made for a direct current (dc) battery voltage.

c. The VHF and UHF receivers are normally crystal controlled. However, provision for the use of an external precision oscillator instead of a crystal for frequency control is included.

d. The VHF and UHF receivers are designed with the capability to operate two receivers in parallel on a single antenna. The VHF receivers on the same antenna must be tuned to channels separated by a minimum of 1 MHz. The UHF receivers on the same antenna must be tuned to channels separated by a minimum of 3 MHz.

e. Both VHF and UHF receivers are compatible with Speech Security Equipment TSEC/KY-8, Speech Security Equipment TSEC/KY-28, and Speech Security Equipment TSEC/KY-38.

NOTE

See table 1-1 for dimensions and weight.

f. When VHF/UHF receiver is used in an environment of high radar noise interference, an optional module, A5, noise limiter is used in place of module A5, the buffer amplifier.

1-8. Differences Between AN/GRR-23 and AN/GRR-24

a. The difference between Receiver, Radio AN/GRR-23 and Receiver, Radio AN/GRR-24 is in the frequency of operation (para 1-7*b*). The VHF and UHF receivers operate on a single channel determined by the frequency of the plug-in crystal used in the oscillator module.

b. The chassis, wiring, and certain modules of the VHF and UHF receivers are identical. A VHF receiver can be converted to UHF operation by exchanging certain VHF determining modules for their UHF counterparts. Similarly, a UHF receiver can be converted to VHF by exchanging these modules. Those modules which must be exchanged for frequency band conversion are the following:

(1) Antenna coupler (A7).
(2) Tunable filter (FL2).
(3) Mixer multiplier (A2).

c. There are some differences between the controls on the VHF mixer multiplier (1A2) and the UHF mixer multiplier (2A2). These differences are described in detail in table 3-1.

1-9. Items Comprising an Operable Equipment

An operable equipment is comprised of a VHF or UHF receiver and an accompanying interface cable kit.

Table 1-1. Items Comprising an Operable Equipment

Item (one each)	Function	Dimensions and weight	NSN
Receiver, Radio AN/GRR-23	VHF receiver	3½ in. high, 19 in. wide, 12¼ in. deep, 22 lb	5820-00-123-3937
or			
Receiver, Radio AN/GRR-24	UHF receiver	Same as above	5820-00-123-3945
and			
Interface cable kit consisting of—	Cable kit		5935-00-809-0786
(1) Clamp MS3057-10A	Clamp (used on J2)		
(2) Connector MS3108A18-1SS	Connector (used on J2)		
(3) Ac cable assembly (used on J1)	Ac power cable	About 6 ft	

1-10. Running Spares

NOTE

See figure 3-1 for location of fuses and lamps.

a. Running spares for the VHF and UHF receivers consist of spare lamps and fuses. Three spare fuses are found on the inside top cover which can be removed by unscrewing the six Phillips-head screws which hold it to the chassis. These three spare fuses include one each of the following:

(1) 250-volt, 1/2-amp fuse (5920-280-8344) for use in F1 or F2 with 210- or 240-volt ac line.

(2) 25-volt, 1-amp fuse (5920-280-8342) for use in F1 or F2 with 105- or 120-volt ac line.

(3) 250-volt, 3-amp fuse (5920-010-6652) for use in F3 dc input.

b. Spare lamps for DS1 must be ordered. Order NE51, FSN 6240-223-9100.

1-11. Technical Characteristics

NOTE

All characteristics below pertain to both the VHF and UHF receivers unless otherwise noted. See table 1-1 for dimensions.

a. Environmental Requirements.

Operating:	
Ambient temperature	−29° C to +60° C.
Relative humidity	5% to 95%.
Altitude	0 to 10,000 ft.
Nonoperating and storage:	
Ambient temperature	−62° C to +71° C.
Relative humidity	5% to 95%.
Barometric pressure	3.34 inches Hg to 31 inches Hg.

b. Electrical Characteristics.

Input power	105, 120, 210, or 240 volts ± 10%, single-phase, 47 Hz to 420 Hz, 65 watts maximum. If ac power fails, 24-volt lead acid battery is automatically switched in to provide emergency power for minimum period of 15 hours.
VHF receiver frequency range	116.00 MHz to 149.95 MHz with 680 channels spaced 50 kHz apart.
UHF receiver frequency range	225.00 MHz to 399.95 MHz with 3500 channels spaced 50 kHz apart.
Duty cycle	Continuous unattended.
Warmup time	30 minutes.
Intermediate frequency	20.6 MHz.
Crystal	Not supplied. Stability to achieve frequency accuracy of ±0.001%. See table 2-1 for determining desired frequency of crystal.
Frequency accuracy	Crystal controlled, semiconductor proportionally controlled crystal oven. No more than ±0.001% drift from operating frequency after 30-minute warmup.
Sensitivity	With a 3.0-μv signal (vhf and uhf) 30% ±5% modulated at 1 kHz applied to antenna input from a 50-ohm source, an output of 100 milliwatts into a 600-ohm load with a 10-db (minimum) signal-plus-noise to noise ratio is obtained.
Selectivity:	*Attenuation* / *Bandwidth*
(50-kHz channel spacing)	6 db - ± 18 kHz minimum. 80 db - ± 40 kHz maximum.
If output	With 3.0-μv signal 30% modulated produces a nominal output of 10 mv at 20.6 MHz.
Audio output	Two unbalanced ungrounded transformer outputs, each 100 milliwatts into 600-ohm resistive load.
Audiofrequency response	Not more than +1 db or −2 db from 300 Hz to 3000 Hz.
Automatic gain control	Receiver output shall not vary more than 3 db as a 6-μv input signal modulated 30% ±5% is increased to 1 volt.
Automatic gain control time constant	100-millisecond attack; 100-millisecond decay maximum.
Squelch	Receiver output muted pending carrier application of not greater than 3.0 μv with squelch sensitivity at maximum setting and not less than 50 μv with squelch sensitivity at minimum setting.
Noise limiter (A5) (When receiver contains nose limiter module.)	For use in installations where radar pulse interference is high; replaces buffer amplifier module.
Buffer amplifier (A5) (When receiver contains buffer amplifier module.)	Provides impedance matching and isolation of the crystal filter (FL-1) from the mixer-multiplier (A2).
Secure voice capability	Provides compatibility with the TSEC/KY-8, −28, and −38 Speech Security Equipment when wide bandwidth crystal filter, is used. Output available at J2-G on receiver rear panel.

1-12. Reference Designations

Reference designation for module and assemblies must be prefaced with 1 for VHF receivers or 2 for UHF receivers. Reference designations for components should be prefaced with assembly designations and 1 for VHF receivers or 2 for UHF receivers. All schematic diagrams, block diagrams, and parts location illustrations use reference designations.

CHAPTER 2

SERVICE UPON RECEIPT AND INSTALLATION

Section I. GENERAL

2-1. Site and Shelter Requirements

The VHF and UHF receivers are installed in standard relay racks in the airfield control tower. No site and shelter planning on the part of the user is required as the racks have provision to accept the chassis.

2-2. Unpacking

a. The VHF and UHF receivers are packed in separate cleated 3/8-inch plywood boxes. The receivers are packed in snug fitting, expanded polystyrene containers, and then completely sealed in a barrier pouch and packed in the plywood box.

b. Table 1-1 shows the unpacked dimensions and weight of the VHF and UHF receivers. The packed dimensions are 9 1/2 inches, 23 inches wide, 24 inches deep, and the weight is 38 pounds.

2-3. Checking Unpacked Equipment

a. Inspect the equipment for damage incurred during shipment. If the equipment has been damaged, report the damage on DD Form 6.

b. Check the equipment against the items in table 1-1 and against the packing slip to see if the shipment is complete. Report all discrepancies in accordance with the instructions of TM 38-750. The equipment should be placed in service even though a minor assembly or part that does not affect proper functioning is missing.

c. Check to see whether the equipment has been modified. (Equipment which has been modified will have the MWO number on the front panel, near the nomenclature plate.) Check also to see whether all currently applicable MWO's have been applied. (Current MWO's applicable to the equipment are listed in DA Pam 310-7.)

d. Check the latest issue of DA Pam 310-4 to see whether you have the latest editions of all applicable maintenance literature.

Section II. INSTALLATION INSTRUCTIONS

2-4. General

a. Purpose and Scope. Initial installation of the VHF or UHF receiver will be performed using a standard engineering package for Army airfields. Information concerning installation contained in this manual is provided in case the receiver must be relocated at some later date, or it must be removed and replaced for maintenance and repair purposes. This information describes a typical installation in general terms and no attempt is made to give detailed installation procedures for all cases. Removal and replacement of the receiver must be performed by direct support or higher maintenance category. However, organizational personnel may refer to the following installation instructions for the purpose of verifying correct installation and cable connections, and for replacement of plug-in items such as fuses and lamps. The brackets shown in figure 2-3 and angle supports shown in figure 2-4, unless on hand, must be fabricated. Figures 2-3 and 2-4 are provided to aid in fabrication of the brackets should this prove necessary.

b. Tools. With the exception of the fabrication of the mounting brackets and angle supports, not to be fabricated by support personnel, all installation procedures may accomplished using tools found in Tool Kit, Electronic Equipment TK-100/G.

c. Test Equipment. Tuneup procedures (sec. III below), to be performed upon installation and as needed in maintenance and repair, require the following test equipments:

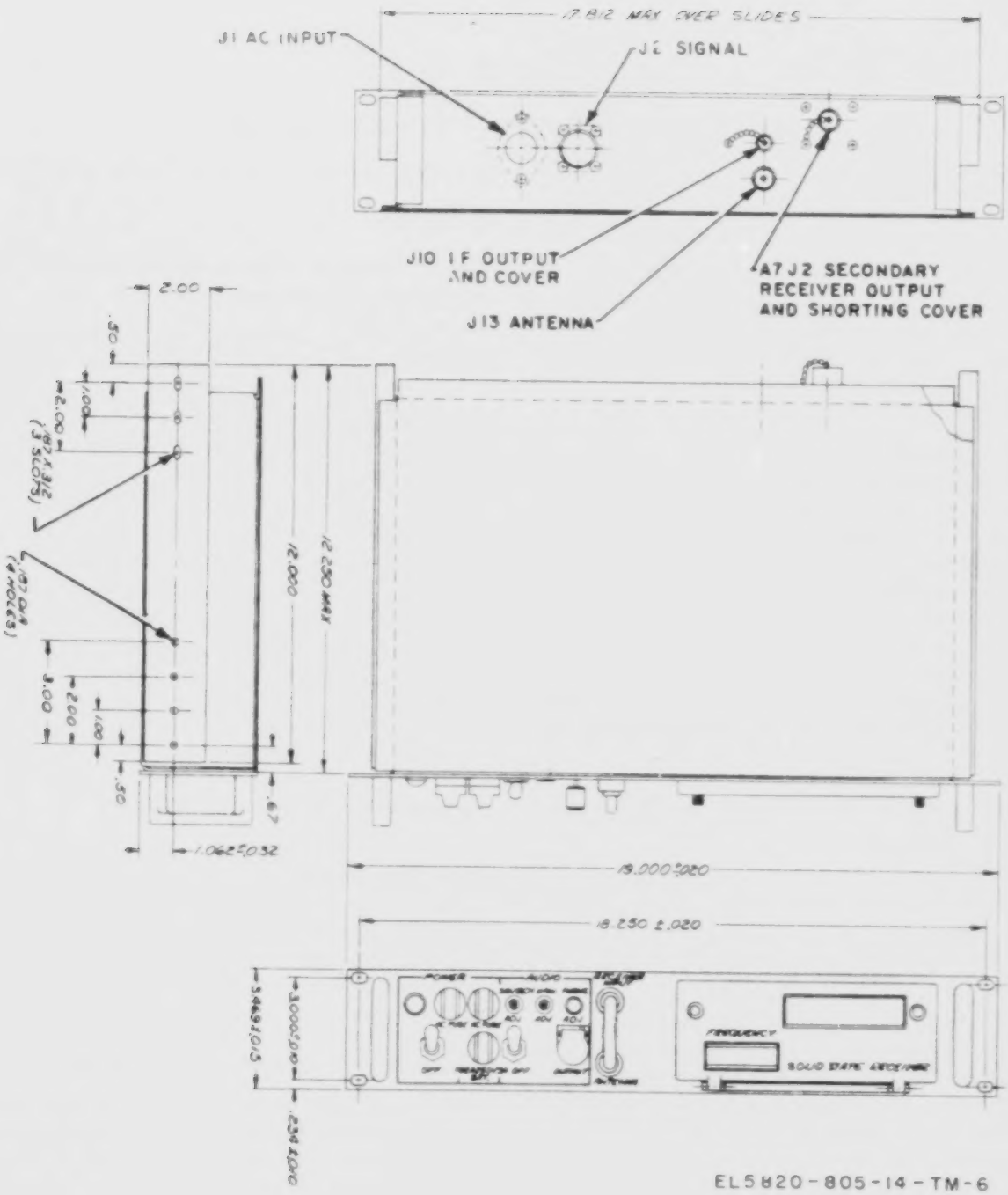
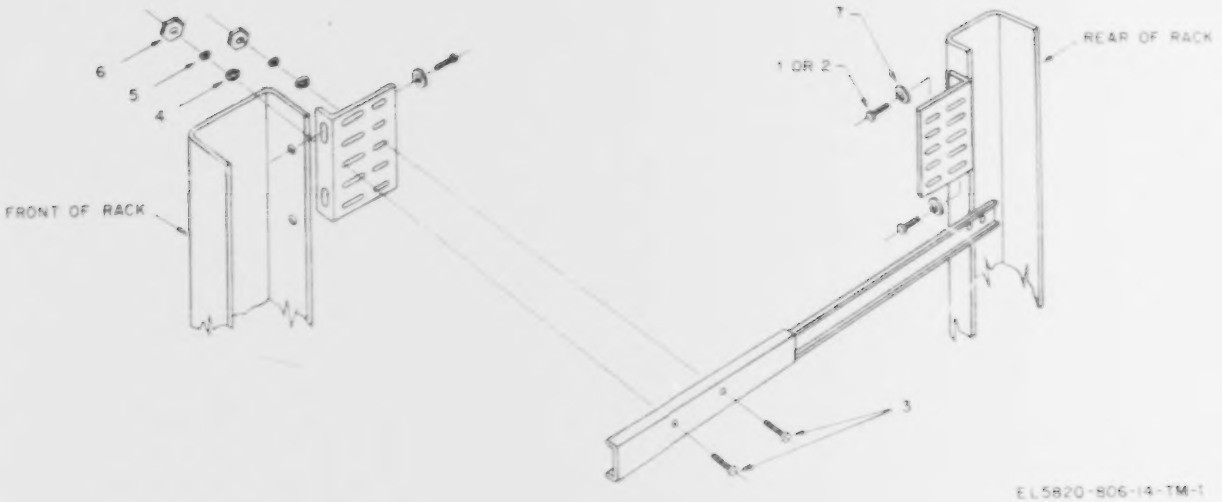


Figure 2-1. VHF/UHF receiver, outline dimension drawing.



1 Screw, rack ¼-28 x ⅜"
2 Screw, rack #12-24 x ½"
3 Screw, machine #10-32 x ⅜"
4 Washer, flat rd. #10
5 Washer, lock #10
6 Nut, hex #10-32
7 Washer, flat ¼"

Figure 2-2. Typical view of MT-686/GR rack mounting (right side).

Item	Common name	FSN
Multimeter ME-26 ( )/U	Multimeter	6625-360-2493
Voltmeter, Electronic ME-30( )/U	Ac voltmeter	6625-643-1670
Generator, Signal AN/USM-44	Signal generator	6625-669-4031
Counter, Electronic AN/USM-207	Counter	6625-911-6368

d. Installation Planning. Since there exists a provision in airfield tower racks for accepting the receivers, very little installation planning is required. Determine the frequency of operation and the frequency of the crystal required (table 2-1). Determine external connections to be made (para 2-6), including whether secure voice operation is required. Determine whether normally supplied buffer amplifier module A5 will be used or whether sufficient radar pulse interference is present to require the substitution of optional noise limiter module A5. The noise limiter effectively blanks radar pulses. See paragraphs 2-5, 2-6, and 2-7 for further planning requirements.

2-5. Installation in Rack

a. The VHF and UHF receivers are provided with a three section slide attached to each side of the chassis (figs. 2-1 and 2-2). The stationary member of each slide is provided with four 3/16-inch holes at one end and three 3/16-inch slots at the other end. These holes and slots are used for attaching the slides with machine screws to the corresponding mounting brackets on the rack (fig. 2-2). Brackets used in mounting the slide to the rack must be fabricated at the time of installation (fig. 2-3). In addition, since there are two kinds of racks which can accept the receiver (MT-686/GR rack and CY-597/G cabinet), a support angle (fig. 2-4) may also need to be fabricated. This support angle is used in addition to the four mounting brackets required for each chassis on the CY-597 cabinet installation. The MT-686 rack installation requires four mounting brackets but no support angle.

b. After the slides have been firmly attached to the mounting brackets and the rack, connect the cables to their proper connectors at the rear of the receiver by following the instructions given in paragraph 2-6.

c. After making all connections, except to ac primary power, install plug-in items (para 2-7). Connect ac power (para 2-6*d*). Tune or perform operational checkout as required. Slide into rack; be careful not to pinch or damage cables. Secure receiver in place.

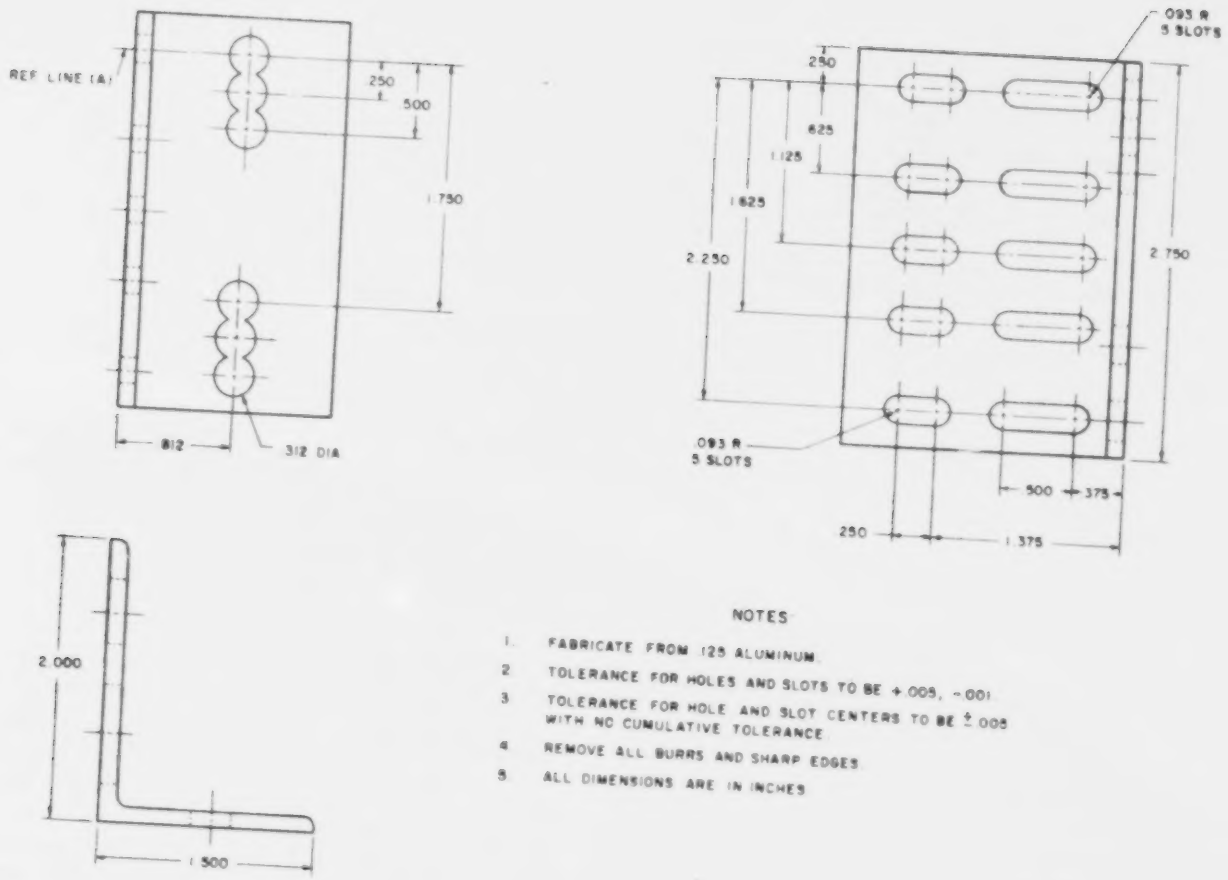


Figure 2-3. Mounting brackets, dimension drawing.

2-6. Cable and Wiring Connections

WARNING

Disconnect the receiver from the ac power source before making or checking cabling and wiring connections at the rear.

a. Remote Connections at J2 on Rear Panel. The connections available at J2 are for connecting remote equipment to the receiver. Which connections are used depends on each installation plan. The interface cable kit contains a connector and clamp (fig. 1-1) for use at J2 but contains no wires. A description of the purpose of the individual pins of J2 is found below.

(1) *Pin A.* Pin A is the connection for an external 22- to 30-volt lead-acid battery. This battery is automatically switched in as the receiver power source if the ac source fails. The positive terminal of the battery should be connected to pin A and the negative terminal to ground pin B or H.

(2) *Pin B.* Pins B and H are the ground pins.

(3) *Pins C and D.* Pins C and D are at the ends of audio output transformer secondary coil and provide the main audio output for connection if a 600-ohm remote headset or speaker.

(4) *Pin E.* Pin E is connected to the center tap of the audio output transformer.

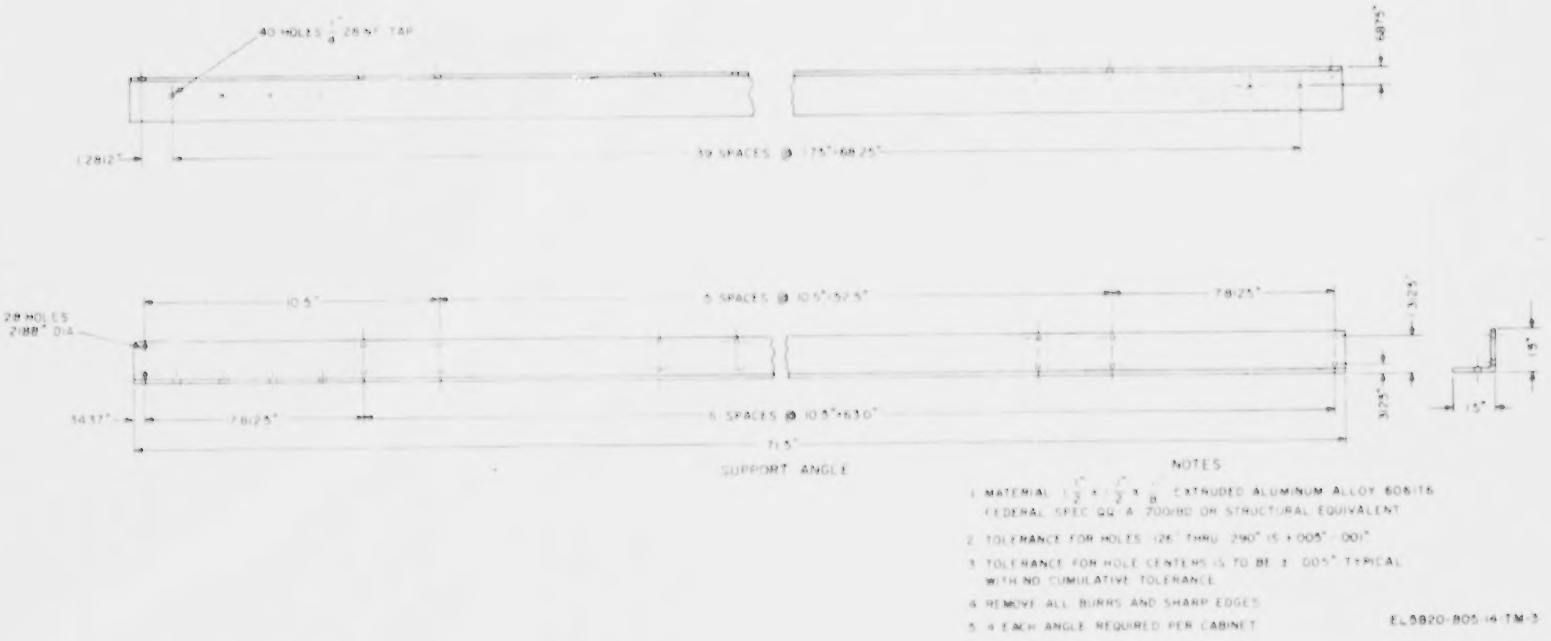


Figure 2–4. Angle supports for use with CY–597/G cabinet installation, dimension drawing.

Figure 2-5 Deleted

(5) *Pin F.* Pin F allows sampling of the automatic gain control signal used for audio compression within the receiver.

(6) *Pin G.* Pin G provides a wide band audio of 25-kHz bandwidth. This audio is uncompressed with no automatic gain control within receiver. It is for use with voice security equipment.

(7) *Pin H.* Pins H and B are ground connections.

Attenuation (db)	K	R_1 Ohms	R_2 Ohms
0	1	∞	0
10	3.16	1155	426
15	5.6	861	813
20	10.0	733	1485
25	17.7	671	2646
30	31.6	639	4735
35	56.0	622	8397

b. Antenna Connection for One Receiver per Antenna. No cable is supplied in the interface cable kit for connecting the receiver to the antenna. Use 50-ohm coaxial cable to connect J13 on rear panel to the antenna.

CAUTION

Be sure shorting cap is in place on A7J2 on receiver rear panel.

c. Antenna Connection for Two Receivers per Antenna. When it is desired to operate two receivers from a common antenna, proceed as follows:

(1) Tune the two receivers using the tuning procedure indicated in paragraph 2-10 or paragraph 2-11. The frequencies of the two receivers must be separated by 1.0 MHz or more if they are VHF receivers and 3.0 MHz or more if they are UHF receivers.

(2) Connect the two receivers as shown

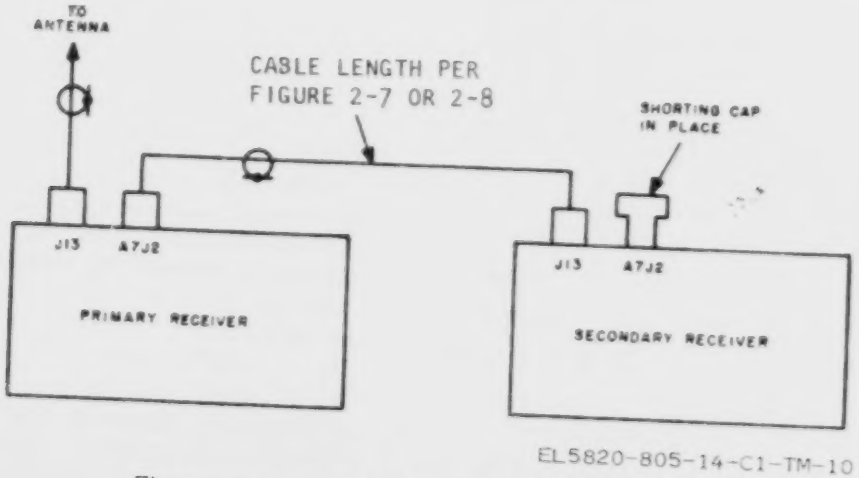


Figure 2-6. Connection for two VHF or UHF receivers operating from a common antenna.

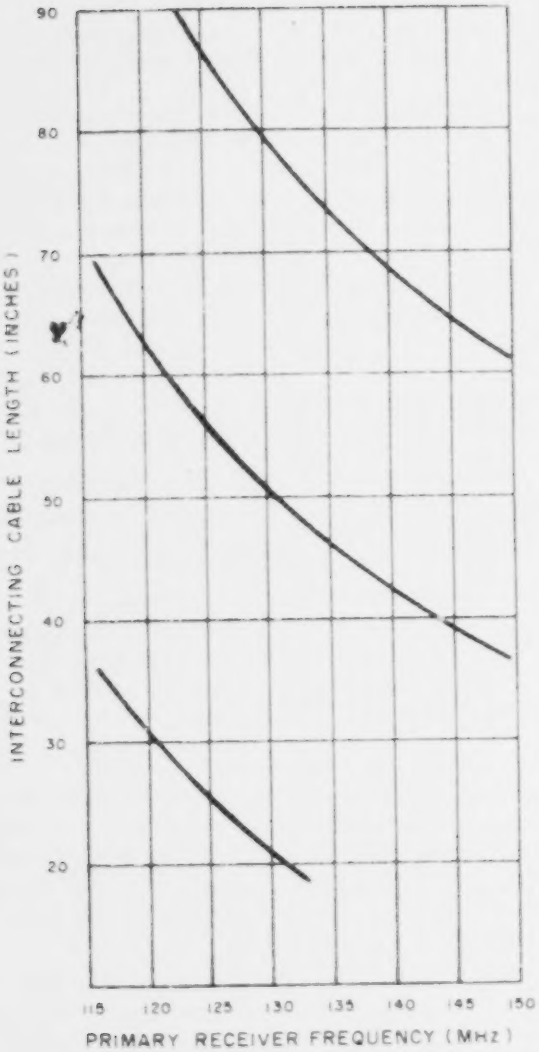


Figure 2-7. VHF receiver, interconnecting cable length vs frequency.

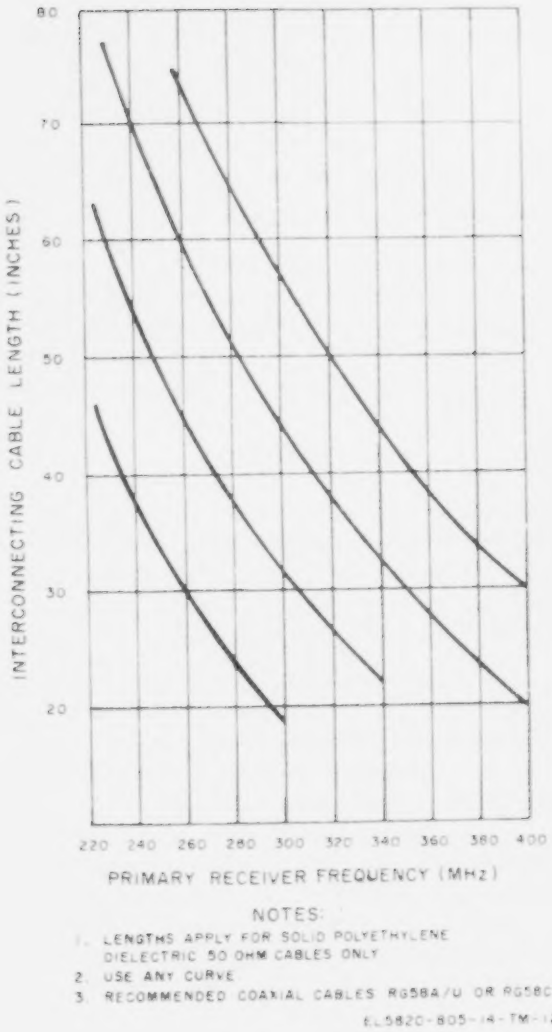


Figure 2-8. UHF receiver, interconnecting cable length vs frequency.

in figure 2-6. The proper length of cable between the two receivers must be used. The cable length s determined by the frequency of the primary receiver (fig. 2-6). See figure 2-7 or 2-8 for the proper cable length. Where more than one length is given, either may be used. At the higher frequencies, cable lengths become more critical for optimum receiver performance. Length is to be measured to the end of the center pin of the coaxial line. Total length should include any

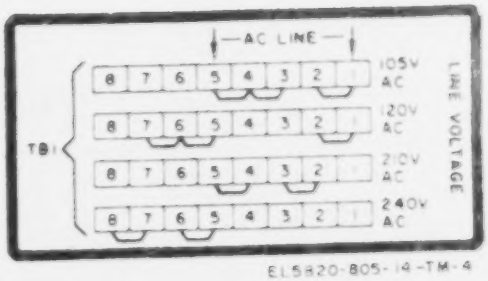


Figure 2-9. Strapping arrangement for input transformer terminal board (FS1TB1) on VHF/UHF receivers.

adapters used when the cable is not terminated with type N connectors.

NOTE

Approximately 2.5-db degradation in sensitivity will be experienced with two receivers connected for operation from a common antenna.

d. Ac Power Connection.

WARNING

Do not connect ac power cord to ac source until all other connections have been made and all plug-in items have been installed in the receiver (para 2-7).

CAUTION

Do not connect the receiver to the ac source before checking the strapping arrangement as instructed below.

(1) Remove receiver top cover by unscrewing the six 6-32 Phillips-head screws which hold it to the chassis. Lift off the cover.

(2) Remove the metal cover over the terminal board on module PS1 (fig. 6-1) by unscrewing the two 4-40 panhead screws.

(3) Determine voltage of the ac primary source to be applied to the receiver.

(4) Check to see that the strapping of TB1 conforms to that illustrated in figure 2-9 for the appropriate voltage of the ac source.

(5) Connect the ac power cable found in the interface cable kit (fig. 1-1 and table 1-1) between J1 on receiver rear panel and the ac primary source.

WARNING

Do not connect ac power cable to ac primary source if plug-in items are to be installed.

2-7. Installation of Plug-in Items

WARNING

Be sure that the ac power cord of the receiver is not connected to the ac primary source when installing fuses or lamps.

a. Fuses. There are three fuse receptacles in the receiver. Fuses F1 and F2 (fig. 3-1) are in the ac line. The value of the ac primary source determines the value of the fuses used. In the ac line (F1, F2), when the ac source voltage is 210 to 240 volts, use F02A250V1/2A, a 250-volt, 1/2-ampere fuse. In the ac line (F1, F2), when the ac source voltage is 105 to 120 volts, use F02A250V1A, a 250-volt, 1-ampere fuse. In the dc line (F3), use F02A250V3A, a 250-volt, 3-ampere fuse. Fuse installation is conventional. Fuse receptacles glow when fuse is blown.

b. Lamp. 1DS1 takes NE51 bulbs. Installation is conventional. Cover is removed by unscrewing.

CAUTION

Be very careful when inserting or removing the crystal holder. Be sure pins are properly aligned. Do not twist holder when inserting or removing, as bent or misaligned pins may result.

c. Frequency Determining Crystal Y1. Frequency determining crystal Y1 is located in the front of oscillator module A1 (fig. 3-1). Determine the operational frequency desired. Use table 2-1 to determine the frequency of the crystal required. Follow the procedure below for installation of Y1.

(1) Open front access door and loosen the two Phillips-head screws which tighten the plastic swivel retainers holding the crystal holder in place in the module. Turn the retainers aside and pull out the holder.

(2) If an undesired crystal is in place between the arms of the holder, remove it. Place the desired crystal in place between the arms of the holder.

(3) Replace holder in cavity, turn retainers in place, and tighten Phillips-head screws.

Table 2-1. Crystal Oscillator Frequency Determination

Receiver	Receiver frequency	Crystal frequency
AN/GRR-23 VHF	116.00 MHz to 149.95 MHz	$\frac{\text{Received Frequency (MHz)} + 20.6}{2}$
AN/GRR-24 UHF	225.00 MHz to 312.00 MHz	$\frac{\text{Received Frequency (MHz)} + 20.6}{4}$
AN/GRR-24 UHF	312.05 MHz to 399.95 MHz	$\frac{\text{Received Frequency (MHz)} - 20.6}{4}$

Section III. PRELIMINARY CHECKS AND TUNEUP PROCEDURE

2-8. Preliminary Checks

CAUTION

Before placing the receiver in operation after installation or repair, perform the following checks.

WARNING

Observe instructions below regarding application and removal of ac power.

a. Check for correct and complete connections (para 2-6).

b. With ac power disconnected, check for correct and complete installation of plug-in items.

c. With ac power disconnected, check for proper strapping of terminal board PS1TB1 (para 2-6).

d. Check for installation of the following modules (fig. 5-1):

(1) Antenna coupler (A7) (para 60-14).

(2) Tunable filter (FL2) (para 6-16).

(3) Mixer multiplier (A2) (para 6-9).

e. Check to be sure that A7J2 shorting cap is in place at rear of receiver.

f. Check for installation of crystal Y1 (para 2-7*c*).

g. Check front panel coaxial jumper between RECEIVER INPUT and ANTENNA jacks (J11 and J12 on fig. 3-1).

2-9. Tuneup, General

Before attempting tuneup, perform preliminary checks given in paragraph 2-8. The VHF or UHF receiver must be tuned upon installation and for each change of channel or received frequency.

After performing tuneup, perform performance test of receiver (table 6-9). Tools and test equipment are those specified in paragraph 2-1. Place function switch of ME-26( )/U for use as voltmeter. Unless otherwise indicated, reference designations and locations of controls can be found in figures 3-1 and 3-2. Test points are on J15 inside front panel access door and are illustrated in figure 3-3.

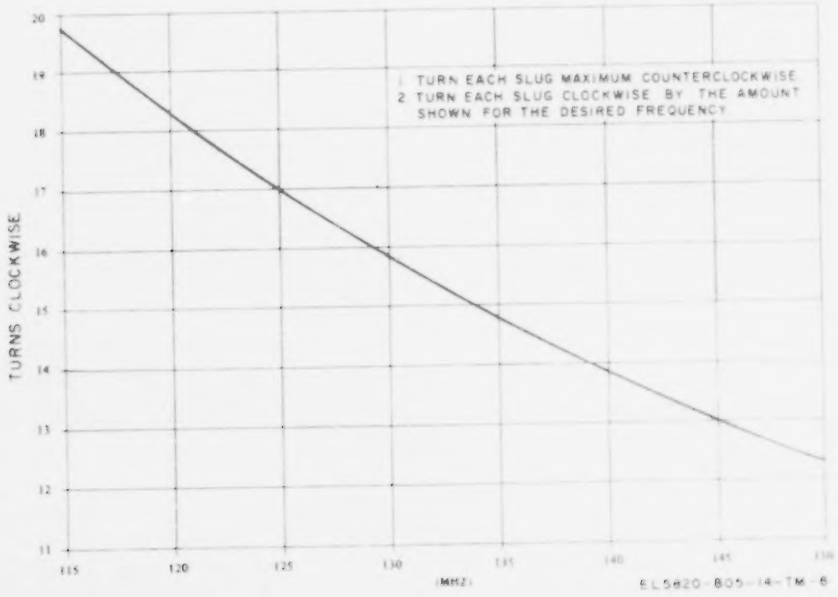


Figure 2-10. VHF receiver tunable filter (FL2), turns of C1 and C2 vs frequency.

2-10. VHF Receiver Tuning Procedures

NOTE

Set POWER ON-OFF switch to ON, observe that POWER indicator lamp is illuminated, and allow 30 minutes for crystal oven stabilization before proceeding with the following tuning procedures. Set switch S1 to OFF, disabling squelch.

a. Using a screwdriver, position the dots on the oscillator module (A1) to line up with the crystal frequency markings. Position the dots on the mixer-multiplier module (A2) to line up with the operating frequency markings.

NOTE

Careful initial setting of the mixer controls is important to avoid subsequent tuning to a wrong harmonic of the oscillator.

b. Refer to figure 2-10 for setting of tunable filter IN and OUT controls and carefully adjust each as indicated.

c. Set multimeter to 1.0 vdc scale and connect between GROUND and LO test point.

NOTE

Be careful when tuning at the extremes of the band (less than 65 MHz and greater than 80 MHz crystal frequency) so that the proper peak is used for maximum frequency accuracy. When tuning at the band edges two peaks are observable because the tuning capacitors have an adjustment range of 360° and two points exist that have the same capacitance. At the extreme low band edge, the capacitance is almost at maximum and with clockwise rotation, its capacitance decreasing. The OSC and BUF adjustments are made for maximum meter indication with the tuning capacitance decreasing. For proper starting position of the capacitor (frequencies less than 65 MHz and greater than 80 MHz) the OSC and BUF controls are adjusted clockwise and counterclockwise to observe the presence of two peaks. The peak closest to the center scale frequency marking of 75 is the correct peak.

d. On the oscillator module, adjust the OSC (C3) control for maximum meter indication.

e. On the oscillator module, adjust the BUF (C13) control for maximum meter indication.

f. Carefully readjust the OSC and BUF controls, alternating between the two, until the maximum meter reading is indicated.

g. On the mixer-multiplier module (A1), adjust the LEVEL ADJ (R26) control fully clockwise.

h. On the noise limiter (A5) (when used), adjust R44 maximum counterclockwise.

NOTE

See figure 6-1 for location of module A5. R44 is marked on top of optional noise limiter module A5.

i. Set multimeter to the 3 vdc scale and connect between GROUND and ×1 MULT test point on J15 (fig. 3-3).

j. Adjust DOUBLER and BUFFER controls for maximum meter indication. Carefully readjust the DOUBLER and BUFFER controls alternately until the absolute maximum meter reading is obtained.

k. Carefully adjust LEVEL ADJ control counterclockwise until the voltage indicated in table 2-2 is obtained for the desired frequency. It is important to use a high input impedance (1 megohm or higher) multimeter for this step, so that the curcuit is not loaded down and the level thus improperly adjusted.

l. Carefully adjust OSC and BUF controls for maximum reading. Care must be used to achieve the maximum peak. Note the peak reading obtained.

m. Detune the OSC control counterclockwise; then carefully adjust it clockwise to the initial peak reading observed in *l* above.

n. Detune the BUF control in the counterclockwise direction then carefully adjust it in the clockwise direction to the initial peak reading observed in *l* above.

o. Repeat *m* above, if the meter reading obtainable when retuning either the OSC or BUF control is greater than or less than that reading obtained in *l* above, start over with *l* above.

p. Set the multimeter to the 10 vdc scale and connect between GROUND and AGC test point.

NOTE

Signal generator frequency should be checked at periodic intervals to assure that signal generator is on frequency.

q. Remove the connector on the front panel between ANTENNA AND RECEIVER INPUT (J12 and J11). Connect signal generator output to RECEIVER IN-OUT (J11) on front panel.

r. Set the SQUELCH (S1) switch to OFF.

s. Adjust signal generator for 30% ±1% modulation at 1 kHz ± 10%.

t. Adjust signal generator for maximum output not greater than 1.0-volt (+13-dbm) output.

Table 2-2. VHF Receiver Multiplier Injection Voltage Levels

Frequency range (MHz)	Injection level (volts)
116.00 to 125.00	0.96 ±0.1
125.05 to 134.00	1.00 ±0.1
134.05 to 143.00	1.04 ±0.1
143.05 to 150.00	1.07 ±0.1

u. Tune the signal generator slowly and carefully across the desired channel frequency. At some point, the meter needle will swing up-scale sharply. Tune the signal generator for maximum indication. If AGC ADJUST (accessible through top cover on receiver) hap-

pens to be grossly misadjusted, it is possible no indication will be obtained. If this is the case, set AGC ADJUST maximum counterclockwise and then turn it slowly clockwise until the age voltage just starts increasing. Then, tune the signal generator frequency for maximum indication on voltmeter.

w. Adjust tunable filter IN and OUT controls (C1 and C2) for maximum meter indication. Carefully readjust the IN and OUT controls alternately until the maximum meter reading is obtained.

x. Reduce the signal generator output to —50 dbm (700 μ v) ±0.5 dbm.

y. Retune the signal generator for maximum meter indication..

z. On the mixer-multiplier module (A2), adjust the RF control (C9) for maximum meter indication.

aa. On the mixer-multiplier module, adjust the ANT control (C1) for maximum meter indication.

ab. Keep reducing the signal generator output and repeating *v*, *x*, *y*, and *z* above as required to obtain the absolute maximum meter indication. Make the last round of adjustments at —97.5 dbm (3.0 μ v) ±0.5 dbm.

NOTE

If —97.5 dbm (3.0 μ v) ±0.5 dbm cannot be obtained in a maximum of three steps, refer to chapter 6 for troubleshooting.

ac. Set the signal generator to —97.5 dbm (3.0 μ v) ±0.5 dbm 30 ±1% modulation at 1 KHz ±10%. Carefully adjust the signal generator frequency for maximum age voltage. Set the voltmeter for 300 millivolts ac full scale and connect the AC probe between the IF and GROUND test point. Adjust AGC ADJUST through top cover for 125 ±5 millivolts; this setting may be changed later.

ad. Set the voltmeter on the 10 vdc scale and reconnect voltmeter to AGC test point. Reduce the signal generator level to —120 dbm (0.224 μ v) ±1 dbm. The age voltage should drop to its quiescent value of 2.9 ±0.3 volt. If it does not drop, set signal generator power level to —120 ±1 dbm and adjust AGC ADJUST through top cover until age voltage drops to its quiescent state of 2.9 ±0.3 volt. Set the signal generator level to —102 dbm (1.78 μ v) ±1 dbm. The age voltage should be 5.0 volts or greater. Set the signal generator level for —97.5 dbm (3.0 μ v) ±1 dbm. The 125 ±5 millivolt reading obtained in *ab* above will read between 120 and 180 millivolts.

ad. Set the signal generator to —97.5 dbm (3.0 μ v) —0.5 dbm, 30% ±1% modulation at 1 kHz ±10%. Adjust the signal generator frequency for maximum age voltage.

ae. Remove receiver top cover and adjust Compression Level (R41) control maximum clockwise.

af. Set voltmeter to 3 vac scale and connect between MAIN AF test point and GROUND on back of front panel door. Adjut AUDIO MAIN ADJ level control on front panel of receiver maximum clockwise.

ag. Adjust RF PREAMPL ADJUST (R32) for 2.00 vac ±25 millivolts.

ah. Adjust AUDIO MAIN ADJ level control on front panel of receiver for 1.6 vac ±25 millivolts.

ai. Adjust PREAMPLE ADJUST (R32) for 2.00 vac ±25 millivolts.

aj. Adjust Compression Level (R41) control for 1.95 vac ±10 millivolts.

ak. Increase signal generator percent modulation from 30% to 90%. Test voltage shall remain within 1.75 to 2.45 volts.

al. Set the voltmeter on the 1 vac scale and adjust the AUDIO MAIN ADJ level control on the front panel until 1 ±0.1 volt is obtained. Note this reading on the db scale of the voltmeter. Switch the signal generator to the CW mode. The voltmeter should drop 10 db or more if the receiver has been properly tuned. Note the change in db. This is the signal-plus-noise ratio (S+N/N).

NOTE

Perform step am only if the receiver contains a noise limiter module (A5). See figure 6-1 for location of module A5. R44 is labeled on top. If the noise limiter is not present, continue tuning at step an.

am. Set R44 on the noise limiter module to approximately midrange. Switch the signal generator back to 30% ±1% modulation at 1 kHz ±10%. Repeat the measurement of the S+N/N ratio as performed in the previous step. It is desired that this be 0.5 db less than what it was with R44 maximum counterclockwise. Adjusting R44 clockwise decreases the S+N/N ratio. Repeat the measurement of S+N/N and adjustment of R44 until the 0.5 db degradation of S+N/N is obtained.

an. Disconnect voltmeter and signal generator. Reconnect antenna connector between ANTENNA and RECEIVER INPUT on front panel. Replace top cover of receiver.

ao. This completes the tuning procedure for operation on any one of the VHF channels.

2-11. UHF Receiver Tuning Procedures

NOTES

1. Set POWER ON — OFF switch to ON, observe the POWER indicator lamp is illuminated, and allow 30 minutes for crystal oven stabilization before proceeding with the following tuning procedures. Set switch S1 to OFF, disabling squelch.
2. Reference designations for controls on

mixer-multiplier module A2 are for VHF receiver only. All other reference designations are identical for both VHF and UHF receivers. UHF controls are located on mixer multiplier module A2 (fig. 3-2) from left to right in the following order.

Control	*Reference designation*
ANT	C30
RF	C35
AMPL	C27
LEVEL ADJ	R17
BUFFER	C11
QUAD	C12

a. Using a screwdriver, position the dots on the oscillator (A1) module to line up with the crystal frequency markings. Position the dots on the mixer multiplier module (A2) to line up with the operating frequency markings.

NOTE

Careful initial setting of the mixer controls is important to avoid subsequent tuning to a wrong harmonic of the oscillator.

b. Refer to figure 2-11 for setting of tunable filter IN and OUT controls (C1 and C2), and carefully adjust each as indicated.

c. Set multimeter to 1.0 vdc scale and connect between GROUND and LO test point.

NOTE

Be careful when tuning at the extremes of the band (less than 65 MHz and greater than 80 MHz crystal frequency) so that the proper peak is used for maximum frequency accuracy. When tuning at the band edges two peaks are observable because the tuning capacitors have an adjustment range of 360° and two points exist that have the same capacitance. At the extreme low band edge, the capacitance is almost at maximum and with clockwise rotation has its capacitance decreasing. The OSC and BUF adjustments are made for maximum meter indication with the tuning capacitance decreasing. For proper starting position of the capacitor (frequencies less than 65 MHz and greater than 80 MHz) the OSC and BUF controls are adjusted clockwise and counterclockwise to observe the presence of two peaks. The peak closest to the center scale frequency marking of 75 is the correct peak.

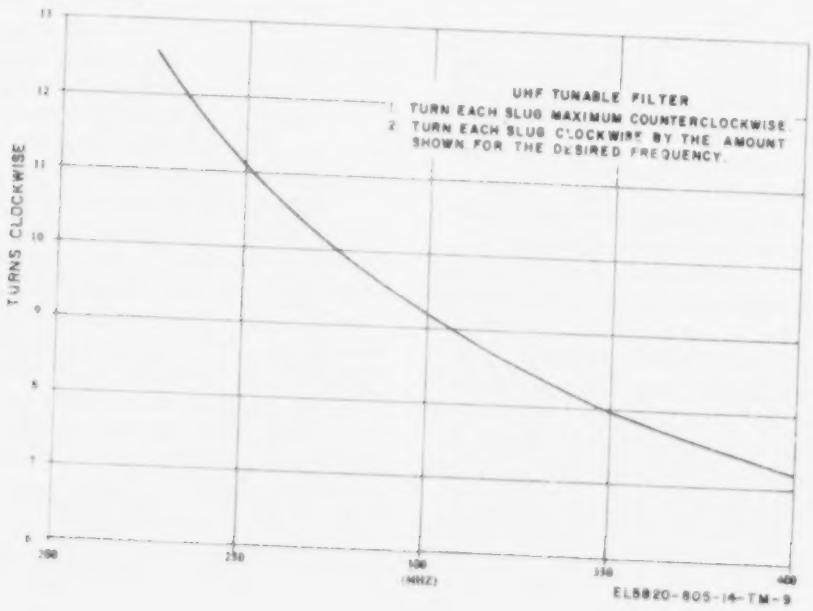


Figure 2-11. UHF receiver Tunable filter (FL2), Turns of C1 and C2 vs frequency.

d. On the oscillator module (A1), adjust the OSC control (C3) for maximum meter indication.

e. On the oscillator module (A1), adjust the BUF control (C13) for maximum meter indication.

f. Carefully readjust the OSC and BUFFER controls, alternating between the two, until the maximum meter reading is indicated.

g. On the mixer-multiplier module (A2), adjust the LEVEL ADJ control (R17) fully clockwise.

NOTE

See figure 6-1 for location of module A5.

h. On the noise limiter A5 (when used), adjust R44 maximum counterclockwise.

i. Set multimeter to the 10 vdc scale and connect between GROUND and MULT test points.

j. Adjust QUAD, BUFFER, and AMPL controls for maximum voltmeter indication. Carefully readjust the QUAD, BUFFER, and AMPL controls alternately until the absolute maximum meter reading is obtained. In some cases, it may be necessary to change the meter to the 30-volt scale.

k. Carefully adjust LEVEL ADJ control (R17) counterclockwise until the voltage indicated in table 2-3 is obtained for the desired frequency.

l. Carefully adjust OSC and BUF controls for a maximum reading. Care must be exercised to achieve the maximum peak. Note the peak reading obtained.

m. Detune the OSC control counterclockwise; then carefully adjust it clockwise to the initial peak reading observed in *l* above.

n. Detune the BUF control in the counterclockwise direction then carefully adjust it in the clockwise direction to the initial peak reading observed in *l* above.

o. Repeat *m* above, if the meter reading obtainable when retuning either the OSC or BUF control is greater than or less than that reading obtained in *l* above, start over with *l* above.

p. Set the multimeter to the 10 vdc scale and connect between GROUND and AGC test point.

NOTE

Signal generator frequency should be checked at periodic intervals to assure that signal generator is on frequency.

q. Remove the connector on the front panel between ANTENNA and RECEIVER INPUT (J12 and J11). Connect signal generator output to RECEIVER INPUT on front panel.

r. Set the SQUELCH switch (S1) to OFF.

s. Adjust signal generator for 30% ±1% modulation at 1 kHz ±10%.

t. Adjust signal generator for maximum output, but not more than 1 volt (+13 dbm).

Table 2-3. UHF Receiver, Multiplier Injection Voltage Levels

Frequency range (MHz)	Injection level (volts)
225.00 to 260.00	2.5 ±0.1
260.05 to 320.00	2.0 ±0.1
320.05 to 340.00	2.5 ±0.1
340.05 to 360.00	3.0 ±0.1
360.05 to 380.00	3.5 ±0.1
380.05 to 400.00	4.0 ±0.1

u. Tune the signal generator slowly and carefully across the desired channel frequency. At some point, the meter needle will swing up scale sharply. Tune the signal generator for maximum indication.

v. Adjust tunable filter (FL2) IN and OUT controls (C1 and C2) for maximum meter indication. Carefully readjust the IN and OUT controls alternately until the maximum meter reading is obtained.

w. Reduce the signal generator output to —50 dbm (700 μv) ±0.5 dbm.

x. Retune the signal generator for maximum meter indication.

y. On the mixer-multiplier module (A2), adjust the RF control (C35) for maximum meter indication.

z. On the mixer-multiplier module (A2), adjust the ANT control (C30) for maximum meter indication.

aa. Keep reducing the signal generator output and repeating *v*, *x*, *y*, and *z* above as required to obtain the absolute maximum meter indication. Make the last round of adjustments at —97.5 dbm (3.0 μv) ±0.5 dbm.

NOTE

If —97.5 dbm (3.0 μv) ±0.5 dbm cannot be obtained in a maximum of three steps, refer to table 6-2.

ab. Set the signal generator to —97.5 dbm (3.0 μv) ±0.5 dbm 30 ±1% modulation at 1 KHz ±10%. Carefully adjust the signal generator frequency for maximum age voltage. Set the voltmeter for 300 millivolts ac full scale and connect the AC probe between the IF and GROUND test points. Adjust AGC ADJUST through top cover for 125 ±5 millivolts; this setting may be changed later.

ac. Set the voltmeter on the 10 vdc scale and reconnect voltmeter to AGC test point. Reduce the signal generator level to —120 dbm (0.221 μv) ±1 dbm. The age voltage should drop to its quiescent value of 2.9 ±0.3 volt. If it does not drop, set signal generator power level to —120 ±1 dbm and adjust AGC ADJUST through top cover until age voltage drops to its quiescent state of 2.9 ±0.3 volt. Set the signal generator level to —102 dbm (1.78 μv) ±1 dbm. The age voltage should be 5.0 volts or greater.

Set the signal generator level for —97.5 dbm (3.0 μv) ±1 dbm. The 125 ±5 millivolt reading obtained in *ab* above may now read between 120 and 180 millivolts.

ad. Set the signal generator to —97.5 dbm (3.0 μv) ±0.5 dbm, 30% ±1% modulation at 1 kHz ±10%. Adjust the signal generator frequency for maximum age voltage.

ae. Remove receiver top cover and adjust Compression Level (R41) control maximum clockwise.

af. Set voltmeter to 3 vac scale and connect between MAIN AF test point and GROUND on back of front panel door. Adjust AUDIO MAIN ADJ level control on front panel of receiver maximum clockwise.

ag. Adjust RF PREAMPLE ADJUST (R32) for 2.00 vac ±25 millivolts.

ah. Adjust AUDIO MAIN ADJ level control on front panel of receiver for 1.6 vac ±25 millivolts.

ai. Adjust PREAMPLE ADJUST (R32) for 2.00 vac ±25 millivolts.

aj. Adjust Compression Level (R41) control for 1.95 vac ±10 millivolts.

ak. Increase signal generator percent modulation from 30% to 90%. Test voltage shall remain within 1.75 to 2.45 volts.

al. Set the voltmeter on the 1 vac scale and adjust the AUDIO MAIN ADJ level control on the front panel until ±0.1 volt is obtained. Note this reading on the DB scale of the voltmeter. Switch the signal generator to the CW mode. The voltmeter should drop 10 db or more if the receiver has been properly tuned. Note the change in db. This is the signal-plus-noise ratio (S+N/N).

NOTE

Perform step am only if the receiver contains a noise limiter module (A5). See figure 6-1 for location of module A5. R44 is labeled on top. If the noise limiter is not present, continue tuning at step an.

am. Set R44 on the noise limiter module to approximately midrange. Switch the signal generator back to 30% ±1% modulation at 1 kHz ±10%. Repeat the measurement of the S+N/N ratio as performed in the previous step. It is desired that this be 0.5 db less than what it was with R44 maximum counterclockwise. Adjusting R44 clockwise decreases the S+N/N ratio. Repe the measurement of S+N/N and adjustment of R until the 0.5 degration of S+N/N is obtained.

an. Disconnect voltmeter and signal generato Reconnect antenna connector between AN TENNA and RECEIVER INPUT on front pane Replace top cover of receiver.

ao. This completes the tuning procedure fo operation on any one of the UHF channels.

2-12. VHF/UHF Receiver Squelch Contro Adjustment

When it is desired to set up the receiver squelc control to operate at a given signal input leve proceed as follows:

a. Remove the front panel connector betwee ANTENNA and RECEIVER INPUT (J12 an J11). Connect signal generator output to RE CEIVER INPUT on front panel (J11).

b. Set the SQUELCH switch (R1) to OFF.

c. Set the multimeter to the 10 vdc scale an connect between the AGC and GROUND tes points (J15, fig. 3-3).

d. Set the signal generator to CW, frequency dia to the indicated channel frequency, and signa generator power level to —97.5 dbm (3.0 μ v) ±0.5 dbm.

e. Carefully adjust the signal generator fine and course frequency controls for maximum age volt age.

f. Set the multimeter to the 30 vdc scale and connect between the SQUELCH test point and GROUND.

g. Set the SQUELCH switch (S1) to ON.

h. Set the signal generator at the desired squelch level (the level must be between —97.5 dbm (3.0 μ v) and —73 dbm (50.1 μ v) ±0.5 dbm).

i. Set the AUDIO SQUELCH ADJ potentiometer (R1) maximum clockwise. The receiver will be squelched and the meter should indicate less than 1 vdc.

j. Slowly turn the AUDIO SQUELCH ADJ potentiometer counterclockwise until the meter suddenly increases to approximately 8.0 vdc.

k. Disconnect the signal generator and replace the connector between the ANTENNA and RE CEIVER INPUT jacks on the receiver front panel.

CHAPTER 3
OPERATING INSTRUCTIONS

Section I. CONTROLS AND INSTRUMENTS

3-1. Damage From Improper Settings

If all connections are correctly made, if all plug-in items are correctly installed, and if the receiver is properly tuned, damage to the equipment cannot result from control settings.

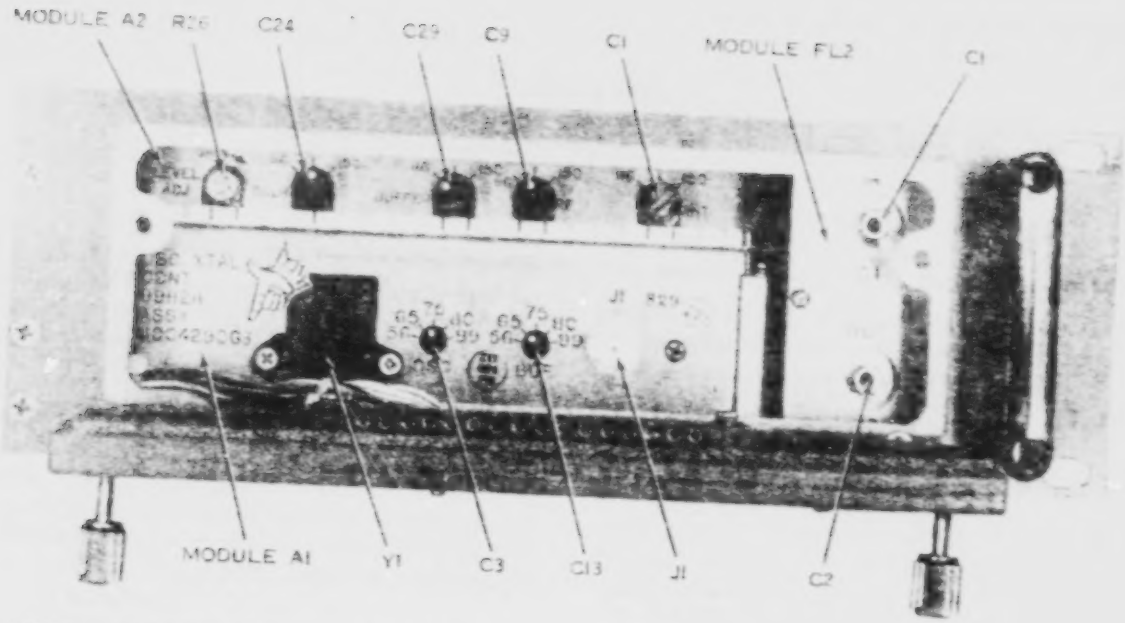
3-2. Controls and Indicators

(figs. 3-1, 3-2, and 3-3)

a. The operator of the receiver will normally be in the air traffic control center and will be called upon to operate headset or speaker only. The controls and indicators found in table 3-1 are for use of organizational and higher categories of maintenance. Organizational maintenance should use only those controls required in performing starting and stopping procedures (paras 3-3 and 3-5) and in performing allocated maintenance duties.

b. Controls and indicators are identical on VHF and UHF receivers except on the multiplier-mixer module (A2). The differences between the controls found on the vhf module and the uhf module are described in table 3-1. Figures 3-1, 3-2, and 3-3 show the VHF receiver only.

Figure 3-1. Receiver, Radio AN/GRR-23, front panel controls and indicators identical on AN/GRR-24.



NOTE REFERENCE DESIGNATIONS ARE PARTIAL. PREFACE WITH MODULE AND UNIT NUMBER 1 FOR VHF AND 2 FOR UHF.

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Figure 3-2. Receiver, Radio AN/GRR-23, controls, and indicators behind front panel access door. (For difference between AN/GRR-23 and AN/GRR-24, see table 3-1.)

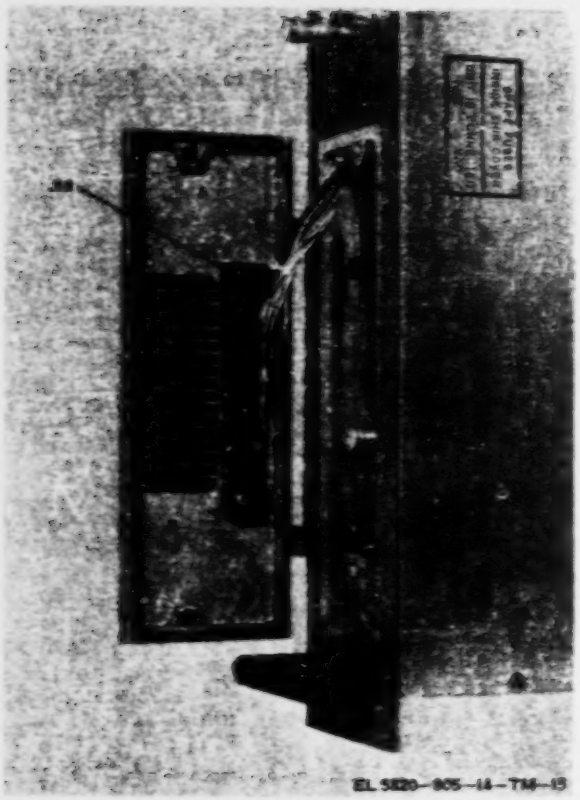


Figure 3-3. Receiver, Radio AN/GRR-23, test points on front panel access door (identical on AN/GRR-24.)

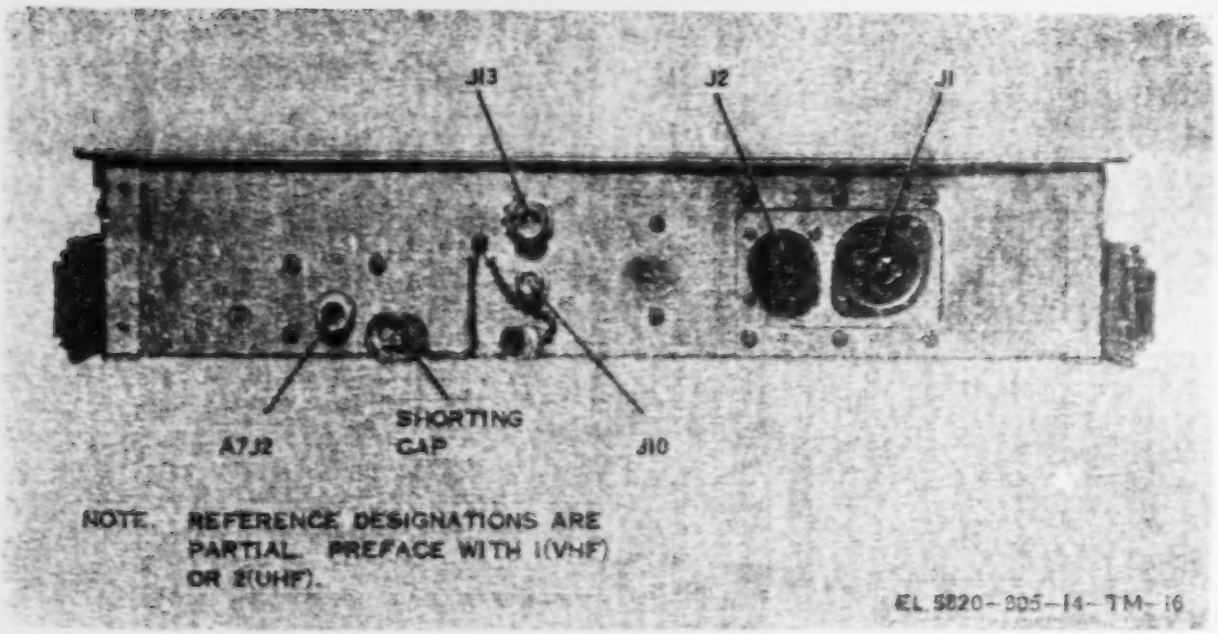


Figure 3-4. Receiver, Radio AN/GRR-23, rear panel connectors (identical on AN/GRR-24).

Table 3-1. Controls and Indicators
(figs. 3-1, 3-2, 3-3, and 3-4)

Control or indicator	Ref des	Function
POWER:	(fig. 3-1)	
ON-OFF:		
Toggle switch	S2	When set to ON, provides primary input power to receiver.
Indicator lamp	DS1	Illuminates when POWER ON-OFF switch is at ON.
AC FUSE (left)	F1	Two 1-ampere fuses in 105-120 vac line. Indicating fuseholders glow when fuse is blown.
AC FUSE (right)	F2	Two 0.5-ampere fuses in 210-240 vac line. Indicating fuseholders glow when fuse is blown.
BAT	F3	Single 3-ampere fuse in positive side of battery input. Indicating fuseholder glows when fuse is blown.
AUDIO:		
SQUELCH ADJ		
Screwdriver adjust	R1	Sets squelch threshold level.
ON-OFF		
toggle switch	S1	When ON-OFF switch is at ON, squelch is operative. With switch at OFF, squelch is disabled.
MAIN ADJ	(fig. 3-1)	
screwdriver adjust	R2	Adjusts level of audio output at rear panel connector.
PHONE ADJ		
knob adjust	R3	Adjusts level of audio at front panel OUTPUT jack.
OUTPUT	J14	Provides audio output for headphone monitoring.
RECEIVER INPUT	J11	Provides front panel disconnect of antenna from receiver input. Provides for signal generator input when tuning receiver.
ANTENNA	J12	
The following controls are behind the front panel access door.		
Tunable filter module (FL2):		
IN:	(fig. 3-2)	
Screwdriver adjust	C1	Tunes input cavity for peak output.
OUT:		
Screwdriver adjust	C2	Tunes output cavity for peak output.
Oscillator module (A1)	(fig. 3-2)	
OSC:		
Screwdriver adjust	C3	Tunes crystal oscillator for peak output.
BUF:		
Screwdriver adjust	C13	Tunes buffer for peak output.
External oscillator input	J1	Allows use of external oscillator in lieu of crystal Y1.
Frequency determining crystal	Y1	Determines operating frequency.
	VHF *UHF*	
Mixer-multiplier module (A2)	(fig. 3-2)	
ANT:		
Screwdriver adjust	C1 C30	Tunes rf amplifier for peak output.
RF:		
Screwdriver adjust	C9 C35	Tunes mixer for peak output.
	VHF *UHF*	
LEVEL ADJ:	(fig. 3-2)	
Screwdriver adjust	R26 R17	Sets multiplier injection level into mixer.
	VHF *UHF*	
AMPL*:		
Screwdriver adjust	C27	Tunes third section of multiplier for peak output.
BUFFER:		
Screwdriver adjust	C29 C11	Tunes second section of multiplier for peak output.
QUAD (UHF)	C12	
DOUBLER (VHF)	C24	
Screwdriver adjust		Tunes first section of multiplier for peak output.
Rear panel connectors:	(fig. 3-4)	
Ac input	J1	Provides input for ac voltage to receiver.
Signal	J2	Provides for signal input and output.
If. output	J10	Provides for if. output, 50-ohm impedance.

Table 3-1. Controls and Indicators—Continued

Control or indicator	Ref des	Function
Antenna input	J13	Provides antenna input.
Secondary receiver output	A7J2	Provides for secondary receiver output.
On inside front panel access door:	(fig 3-3)	
Test points	J15	See table 6-2 for complete explanation of test points.

Section II. OPERATION UNDER USUAL CONDITIONS

3-3. VHF/UHF Receiver Starting Procedure

(fig 3-1)

WARNING

Disconnect ac power before removing top cover as instructed below.

CAUTION

Receiver should be correctly and completely installed before attempting starting. Tuning and performance checkout may be required before continued operation.

a. Verify that the input power transformer is correctly strapped for the installation voltage as indicated in figure 2-9.

b. To turn on receiver, set receiver front panel POWER ON-OFF switch S2 to ON and observe the following:

b. To turn on receiver, set receiver front panel POWER ON-OFF switch S2 to ON and observe the following:

(1) The POWER indicator lamp (DS1) illuminates.

(2) After a 30-minute warmup period, during which the frequency controlling elements stabilize, the receiver is ready for operation, providing the tuning procedure has been completed for the operating frequency desired.

3-4. VHF/UHF/Receiver Operating Procedure

The VHF and UHF receivers will normally be used in continuous operation after starting procedure has been performed. In either VHF or UHF models, the receiver will continue to receive signals when on, unless disconnected from the antenna by a transmit-receive relay.

3-5. VHF/UHF Receiver Shutdown Procedure

The VHF and UHF receivers are shut down by setting the POWER ON-OFF switch (S2) to OFF.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

3-6. General

Unusual conditions under which the receiver may be operated are limited to unavailability of crystal (Y1) and ac power source failure.

3-7. Unavailability of Crystal Y1

If a crystal of the desired operating frequency (table 2-1) is not available, proceed as follows:

a. Set AC POWER ON-OFF switch at OFF.

b. Remove receiver top cover.

c. Disconnect oscillator cable (P2) from mixer/multiplier module.

d. Remove oscillator cable (P3) from its stowage clip at rear of module and connect it to the mixer/multiplier connector (J1).

e. Secure oscillator P2 cable to stowage clip.

f. Remove crystal from holder and reinstall holder in oscillator module to maintain oven temperature.

g. Connect Generator, Signal AN/USM-44 and Digital Readout Electronic Counter AN/USM-207 to J1 on the oscillator module. See table 2-1 to determine setting of rf generator frequency for proper channel operating frequency.

h. Adjust external rf generator for an output from 0.5 to 1.0 volt rms.

i. Replace receiver top cover.

3-8. Ac Power Failure

A 24-volt battery should be connected to J2, pin A (+) and pin B or H (ground, − terminal). If ac power fails, switch over to dc battery operation is automatic. If the battery is disconnected, see paragraph 2-6*a* for connection instructions (DS or above). If battery is dead but connected, see troubleshooting tables in chapter 6.

CHAPTER 4

OPERATOR AND ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. GENERAL

4-1. Scope of Maintenance

a. MAC. Operator and organizational maintenance duties shall be those prescribed in the maintenance allocation chart (app. B).

b. Operator Maintenance. Operator maintenance shall be limited to observation of equipment serviceability during normal operation.

c. Organizational Maintenance. Organizational maintenance duties shall be those found in this chapter or referenced within this chapter.

d. Repair Parts. Repair parts shall be those found in TM 11-5820-805-24P.

4-2. Tools and Test Equipment Required

The following tools and test equipment are required for the performance of organizational maintenance duties:

Item	*FSN*
Tool Kit, Electronic Equipment TK-101/G	5180-064-5178
Multimeter AN/URM-105	6625-581-3026

4-3. Repainting and Refinishing Instructions

a. Minor touchup of the front panels of the exciter and the power amplifier is authorized at the organizational category.

b. Paint used is semigloss gray (26152) in accordance with FED-STD-595.

c. TB 746-10 contains further instructions.

NOTE

Be sure not to paint over front panel markings without replacing them.

4-4. Lubrication

The only lubrication required for the VHF/UHF receiver is on the runners. This should be done as needed, using a lightweight machine oil. Apply sparingly.

Section II. ORGANIZATIONAL PREVENTIVE MAINTENANCE

4-5. General

a. Purpose. To insure that the receiver is always ready for operation, it must be inspected systematically so that defects can be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance checks and services to be performed are listed and described in paragraph 4-6. Defects discovered during operation of the unit will be noted for future correction to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noted during operation which would damage the equipment. Record all deficiencies together with the corrective action taken in compliance with TM 38-750.

b. Time Periods. Preventive maintenance checks and services of the receiver are required at organizational category daily, weekly, and monthly.

4-6. Instructions for Performance of Organizational Preventive Maintenance Checks and Services

a. Instructions for the performance of organizational preventive maintenance checks and services are found in tables 4-1 and 4-2 below. If the equipment must be kept in continuous operation, check and service only those items that can be checked and serviced without disturbing operation; make the complete checks and services when the equipment can be shut down.

b. Monthly organizational maintenance should call in direct support maintenance to perform a performance checkout of the receiver.

Table 4-1. Operator/Crew Preventive Maintenance Checks and Services

NOTE
THE CHECKS IN THE "INTERVAL" COLUMN ARE TO BE PERFORMED IN THE ORDER LISTED
D — During Operation S — Special Situation*

ITEM NO.	INTERVAL		Item to be Inspected	Procedures Check and have repaired or adjusted as necessary	Equipment is not ready/available if:
	D	S			
1	●	●	Receiver background noise	Plug a set of 600-ohm headphones into AUDIO OUTPUT jack and adjust AUDIO PHONE ADJ Control until receiver background noise is heard. Be sure AUDIO SQUELCH switch is at OFF.	
2	●	●		Perform an operability check IAW the operating instructions in Chapter 3 of this technical manual.	The operability check results in a condition whereby the equipment will not be able to complete its intended mission because of malfunction, lack of required equipment or non-application of an URGENT MWO.

*Perform whenever the readiness condition of the equipment is required.

Table 4-2. Organizational Preventive Maintenance Checks and Services

NOTE
THE CHECKS IN THE "INTERVAL" COLUMN ARE TO BE PERFORMED IN THE ORDER LISTED.
W — Weekly M — Monthly

ITEM NO.	INTERVAL		Item to be Inspected	Procedures Check and have repaired or adjusted as necessary
	W	M		
1	●		Test Points	Using multimeter (para 4-2), measure between each of the test points of J15 (inside front panel access door) and ground (pin 16, J15). Use the scale appropriate to measure the values given in table 4-4. If values do not conform to those in table 4-4 under the conditions in paragraph 4-9, refer to table 4-3 for troubleshooting.
2		●	Runners	Check for free movement on runners. Lubricate if necessary. Para 4-4.
3		●	Spare Fuses	With AC power off, remove top cover by loosening Phillips head screws and check for presence of spare fuses on inside of cover.
4			Performance Test	Refer to DS for monthly performance checkout.

Section III. ORGANIZATIONAL TROUBLESHOOTING OF VHF AND UHF RECEIVERS

4-7. General

a. Troubleshooting procedures are the same for VHF and UHF receivers unless otherwise noted.

b. Organizational troubleshooting and repair will be confined to front panel lamps, fuses, coaxial jumper, and AUDIO PHONE ADJ knob, and to rear panel connections and cable continuity. Organizational maintenance will troubleshoot these before calling in direct support for further troubleshooting.

c. Troubleshooting procedure is based on malfunctions which may be observed in performing preventive checks and services.

4-8. Organizational Troubleshooting

Perform all weekly preventive maintenance checks and services given in table 4-2. Symptoms in table 4-3 below are obtained in the performance of these checks and services. If malfunction cannot be isolated using table 4-3, refer the problem to direct support for troubleshooting and repair.

NOTE
See paragraph 4-9 for checking test points.

Table 4-3. Organizational Troubleshooting of VHF/UHF Receiver

WARNING

Disconnect act power before replacing fuses or lamp.

Symptom	Probable cause	Corrective action
1. Background audible, receiver operative, test points normal, lamp DS1 fails to light.	Lamp defective	Replace DS1 (para 2-7).
2. Fuse receptacle glows, disregarding other symptoms.	Fuse blown	Replace fuse (para 2-7).
3. Receiver dead, DS1 does not illuminate, test points all read 0.	Check to see if POWER ON-OFF switch is at OFF.	If at OFF, perform starting procedure (para 3-3).
	Check connection of ac power cord to J1 on receiver rear panel.	Connect if necessary.
	Check connection of ac power cord to ac source.	Connect if necessary.
	Disconnect ac power cord from ac source and J1 and check continuity.	Replace if necessary.
4. Lamp illuminates, fuses do not glow, background audible, no signal reception, test points normal.	Check for poor connection of coaxial jumper between front panel RECEIVER INPUT and ANTENNA jacks.	Make secure connections if necessary.
	Check for poor antenna connection on rear panel J13.	Make secure connections if necessary.
5. Lamp illuminates, fuses do not glow, background, audible, good signal reception, test points normal, remote audio out, or security equipment (wideband out) fails to function.	Faulty connections on J2 of rear panel. Check (para 2-6).	Make secure connections if necessary.

Section IV. ORGANIZATIONAL MAINTENANCE OF VHF AND UHF RECEIVERS

4-9. Checking Test Point Readings on Inside Front Panel Access Door

(fig. 3-3)

Using Multimeter AN/URM-105, measure the voltages between each of the test points listed in table 4-4 and the ground point on J15. Be sure to use the correct scale on the multimeter required to measure the value indicated in table 4-4. Deviation in reading from the values in the table calls for troubleshooting at the organizational category (table 4-3) and, if necessary, forwarding to direct support. Test conditions: POWER ON-OFF switch to ON, audio ON-OFF switch (squelch) to OFF, and coaxial jumper disconnected from front panel RECEIVER INPUT and ANTENNA jacks.

Table 4-4. Organizational Test Point Readings

Test point on J15	Normal reading
UNREG B+	27 to 40 vdc (ac power), 21.5 to 29.5 vdc (dc battery power).
REG B+	17.01 to 18.00 vdc
AGC	2.6 to 3.2 vdc
SQUELCH	14 to 16 vdc
IF	2.5 to 4.0 vdc
LO	0.25 to 0.8 vdc*
MULT	0.86 to 1.17 vdc (VHF); 2.4 to 4.1 vdc (UHF).
LO OVEN	Varies between 0 and 25 vdc
MIXER OUT	Not used at organizational
NOISE LIMITER	Not used at organizational
AF PREAMP	Not used at organizational
MAIN AF	Not used at organizational

*With external generator input (crystal removed) there will be no reading.

4-10. Replacement and Tightening of Front Panel Attachments

(fig. 3-1)

WARNING

Disconnect ac power from receiver before attempting to remove or install fuses or lamps.

a. Fuses and Lamps. Refer to paragraph 2-7 for information concerning value of fuses and lamps. Installation is conventional.

b. AUDIO PHONE ADJ Knob. Remove knob by loosening the two Allen screws and pulling off. Install by pushing knob on shaft and tightening two Allen screws.

c. Coaxial Jumper Between RECEIVER INPUT and ANTENNA Jacks. Removal and installation of jumper is conventional with BNC male connectors on each end of jumper.

411. Repair of Rear Panel Connections

For information regarding rear panel connections, see paragraph 2-6. Check solder connections on J2, screw-on security of J10 and J13, and male prong contact into J10 and J13 female; J1 is push-on, two-prong male connector. Also check continuity of cables and wires. Connections required vary with installation. Coaxial cables are 50 ohms.

CHAPTER 5
FUNCTIONING OF EQUIPMENT

Section I. BLOCK DIAGRAM EXPLANATION

5-1. General

a. The VHF and UHF recievers are identical except for the modules indicated by the asterisked blocks on figure 5-1.

b. A number of options to the basic receiver configuration are available. First, for installations where radar pulse interference is objectionable, the buffer amplifier (A5) may be replaced by a noise limiter which blanks radar-type pulses. Second, the normal 20.6-MHz crystal filter (FL 1) may be exchanged for a narrow bandwidth unit intended for 25-kHz channel spacing. Note that the normal and 25-kHz crystal filters may be used with either the noise limiter or the buffer amplifier modules in place.

5-2. VHF/UHF Receiver Block Diagram Explanation
(fig. 5-1)

a. The VHF receiver and the UHF receiver are single-conversion, crystal controlled superheterodynes. The receivers are identical in physical configuration but different electrically in the antenna coupler, the tunable filter, and the mixer-multiplier modules.

b. The antenna input is fed to the antenna coupler which provides the capability of operating two receivers from a single antenna. The tunable filter provides preselection on the operating frequency. The local oscillator is crystal-controlled in a temperature-controlled oven. The mixer-multiplier stage doubles (vhf) or quadruples (uhf) the local oscillator frequency and heterodynes the resultant signal with the received signal to produce a 20.6-MHz intermediate frequency. The mixer-multiplier output is fed to a buffer amplifier stage which provides isolation and impedance matching for the crystal filter.

c. The signal from the noise limiter is fed to a 20.6-MHz crystal filter which establishes the receiver selectivity. Four stages of intermediate frequency amplification follow the crystal filter providing a minimum of 86-db gain. After detection, the signal is fed to the audiofrequency preamplifier where it is amplified, and a dual output is fed to the audio amplifier for further amplification providing 100 mw of audio output to the

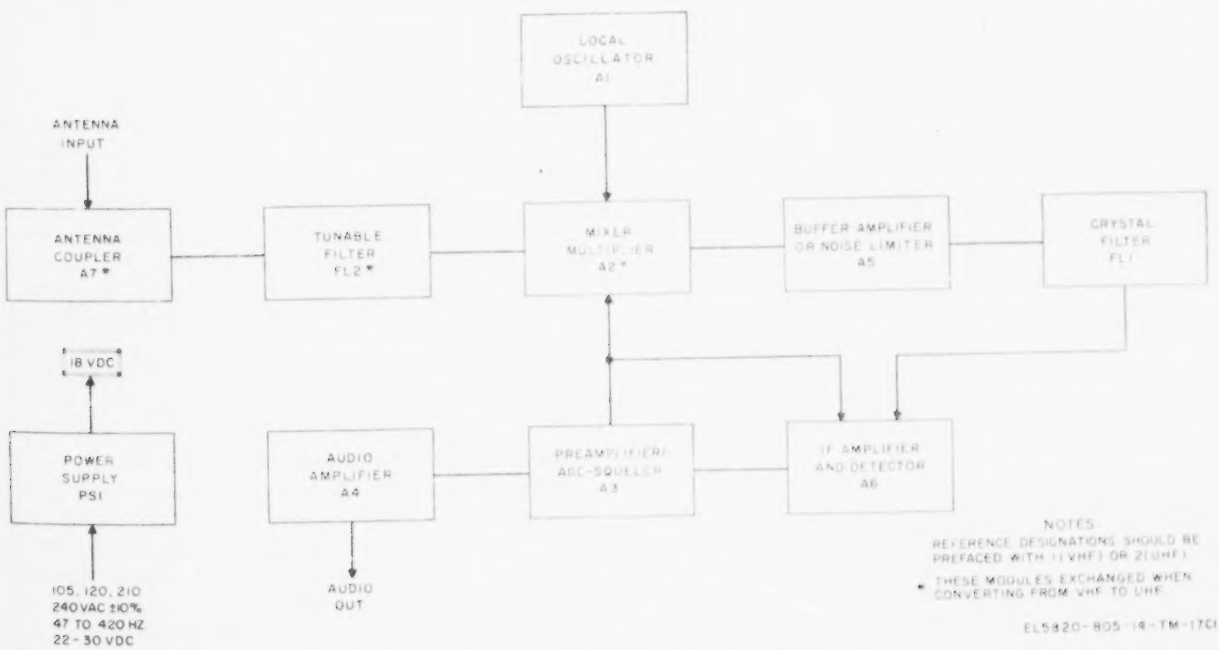

LOCAL OSCILLATOR A1
ANTENNA INPUT
ANTENNA COUPLER A7*
TUNABLE FILTER FL2*
MIXER MULTIPLIER A2*
BUFFER AMPLIFIER OR NOISE LIMITER A5
CRYSTAL FILTER FL1
18 VDC
POWER SUPPLY PS1
AUDIO AMPLIFIER A4
PREAMPLIFIER/ AGC-SQUELCH A3
IF AMPLIFIER AND DETECTOR A6
105, 120, 210 240 VAC ±10% 47 TO 420 HZ 22-30 VDC
AUDIO OUT
NOTES:
REFERENCE DESIGNATIONS SHOULD BE PREFACED WITH 1 (VHF) OR 2 (UHF).
* THESE MODULES EXCHANGED WHEN CONVERTING FROM VHF TO UHF.
EL5820-805-14-TM-17CI

Figure 5-1. VHF/UHF receiver functional block diagram.

phone jack and 100 mw of audio output to the main audio output for remote speaker operation. Automatic gain control is obtained by sampling the detected carrier level voltage, amplifying it, and applying this voltage to the mixer-multiplier and if. amplifier. The agc voltage is also fed to the squelch stage to quiet the receiver in the absence of a received signal.

d. The receiver power supply converts the 47-to 420-Hz ac primary power to regulated and unregulated dc voltages to operate the receiver circuits. When the ac primary input is interrupted, automatic switchover is accomplished to a dc input from an external source.

Section II. SCHEMATIC EXPLANATION OF CIRCUITS

5-3. General

The following are explanations of each of the circuits which make up the VHF and UHF receivers. Unless otherwise indicated, the explanation applies to both the vhf and uhf circuits. Figures referenced below are schematic diagrams for the circuit under discussion. The physical location of the modules containing the circuits can be found in figure 6-1. Figures with FO numbers are foldouts found at the rear of the manual. Figure FO-8 is an overall schematic diagram of the VHF/UHF receiver.

5-4. VHF Receiver Antenna Coupler (1A7)

The antenna coupler allows two VHF receivers to operate from the same antenna. Connector A7J2 on the rear apron of the receiver allows coupling to a second VHF receiver input. The reduced sensitivity to each receiver when the two are operated with a frequency separation of 1 MHz or greater will be a maximum of 2.5 db. When not used, the second receiver output from the antenna coupler must be covered with the chained shorting cap on the receiver rear panel.

5-5. UHF Receiver Antenna Coupler (2A7)

The antenna coupler allows two UHF receivers to operate from the same antenna. Connector A7J2 on the rear apron of the receiver allows coupling to a second UHF receiver input. The reduced sensitivity to each receiver when the two are operated with a frequency separation of 3 MHz or greater will be a maximum of 2.5 db. When not used, the second receiver output from the antenna coupler must be covered with the chained shorting cap on the receiver rear panel.

5-6. VHF Receiver Tunable Filter (1FL2)

The VHF receiver tunable filter consists of two tuned cavity sections. Each section is tunable over a frequency range of from 116 to 150 MHz by adjusting its variable capacitor. Internal coupling is provided between the input and output sections. Insertion loss for the filter is a maximum of 5.5db.

5-7. UHF Receiver Tunable Filter (2FL2)

The UHF receiver tunable filter consists of two tuned cavity sections. Each section is tunable over a frequency range of from 225 to 400 MHz by adjusting its variable capacitor. Internal coupling is provided between the input and output sections. Insertion loss for the filter is a maximum of 5.5db.

5-8. VHF/UHF Receiver Oscillator Module

(fig. 5-2)

a. General. The oscillator module consists of a crystal-controlled oscillator stage, a buffer amplifier stage, and an oven with associated heaters and temperature control circuitry.

b. Crystal Oscillator. Oscillator stage Q1 has its base voltage held at a constant value by a voltage divider consisting of R1 and R2. Crystal Y1 is coupled to the emitter by C4 and to a tap on L2 by phase network Z1. Phase network Z1 controls the phase and magnitude of the drive level to Y1. Phase network Z1 and resistor R5 isolate Y1 from inductive and capacitive effects of the driving circuitry. Coupling network C4 and R4 tends to isolate the crystal from the transistor. Variable capacitor C3 is tunable fro resonance at the crystal frequency. Power supply decoupling is provided by C1, L1, C20, C14, and R23.

c. Buffer Amplifier. The oscillator stage output, from a tap on L2 is coupled through C7 to the base of buffer amplifier Q2. This stage is adjusted for resonance at the crystal frequency by variable capacitor C13. The ouput from a tap on L4 is coupled through C10 and a matching pad consisting of R10 and R11 to coaxial connector P2. The signal at the junction of C10 and R10 is detected by CR1 and applied to receiver front panel test point LO. The signal is filtered by pi-filter C11, L5, and C12 and becomes a positive voltage with a level proportional to the oscillator output. Power supply decoupling is performed by C8, L3, and C5.

d. Oven. A proportional temperature control system is utilized in the oven. The oven is maintained at a near constant temperature (75° ±5°) by heaters HR1 and HR2, and associated sensing and control circuitry. Power for the heaters is supplied by the unregulated output (22 to 40 volts dc) from the power supply module. Resistor R28 is the load resistor for the metering circuit and R25 is the multiplier resistor that furnishes the proper level for the OVEN front panel

major test point. Inductor L6 and C19 furnish decoupling to the oven metering line. The regulated voltage is furnished to the resistance bridge of R13, R16, R14, R19 and RT1. Resistors R12 and R15 establish the dc operating voltage of operational amplifier AR1. Potentiometer R16 is used to control the oven temperature and is adjusted for a temperature of 75 degrees C ±5 degrees. With this adjustment the bridge is balanced and pins 2 and 3 of AR1 are the same voltage. At power turn on, the oven is at room temperature. The resistance of RT1 will be high which will cause pin 3 of AR1 to be low and output of AR1 low. Transistor Q3 will be turned on by the base drive through R22, R20 and VR1. With this conduction the collector current of Q3 furnishes base drive to Q4. Amplifier Q4 is turned on and furnishes collector current through heater element HR1, HR2 from the unregulated voltage through R28. The voltage across R28 is furnished to the front panel for OVEN metering test point. Resistor R30 is to minimize thermal runaway resulting from Q4 operating at high temperature. As the oven approaches the operating temperature, the resistance of RT1 decreases to raise the voltage at pin 3 of AR1 which raises the output voltage of AR1 to decrease drive to Q3 and Q4 which reduces heater current. At the operating temperature the output of AR1 is high so that Q3 is almost turned off which reduces base drive to Q4 and reduces the heater current to almost zero. Zener diode VR1 assures that Q3 is turned off when heater current is not required as in the case when ambient temperatures exceed the oven temperature.

5-9. VHF Receiver Mixer-Multiplier Module (1A2)

(fig. FO-1)

a. The VHF mixer/multiplier module consists of a temperature-compensated and age controlled rf stage, a mixer stage, a local oscillator frequency doubler stage, and a buffer amplifier with a temperature-compensated feedback stage. The rf input from the antenna is coupled through C36 and C37 to a tap on L1. Resonance at the received frequency is achieved by adjusting variable capacitor C1. The signal from a tap on L1 is coupled through C2 to gate 1 of dual-gate field effect transistor Q1. The source of Q1 is supplied through R7 from the cathode of Zener diode VR1. The +3.3 volts established by the diode is used to raise the source of Q1 sufficiently above ground so that the gates may be negatively biased relative to the source.

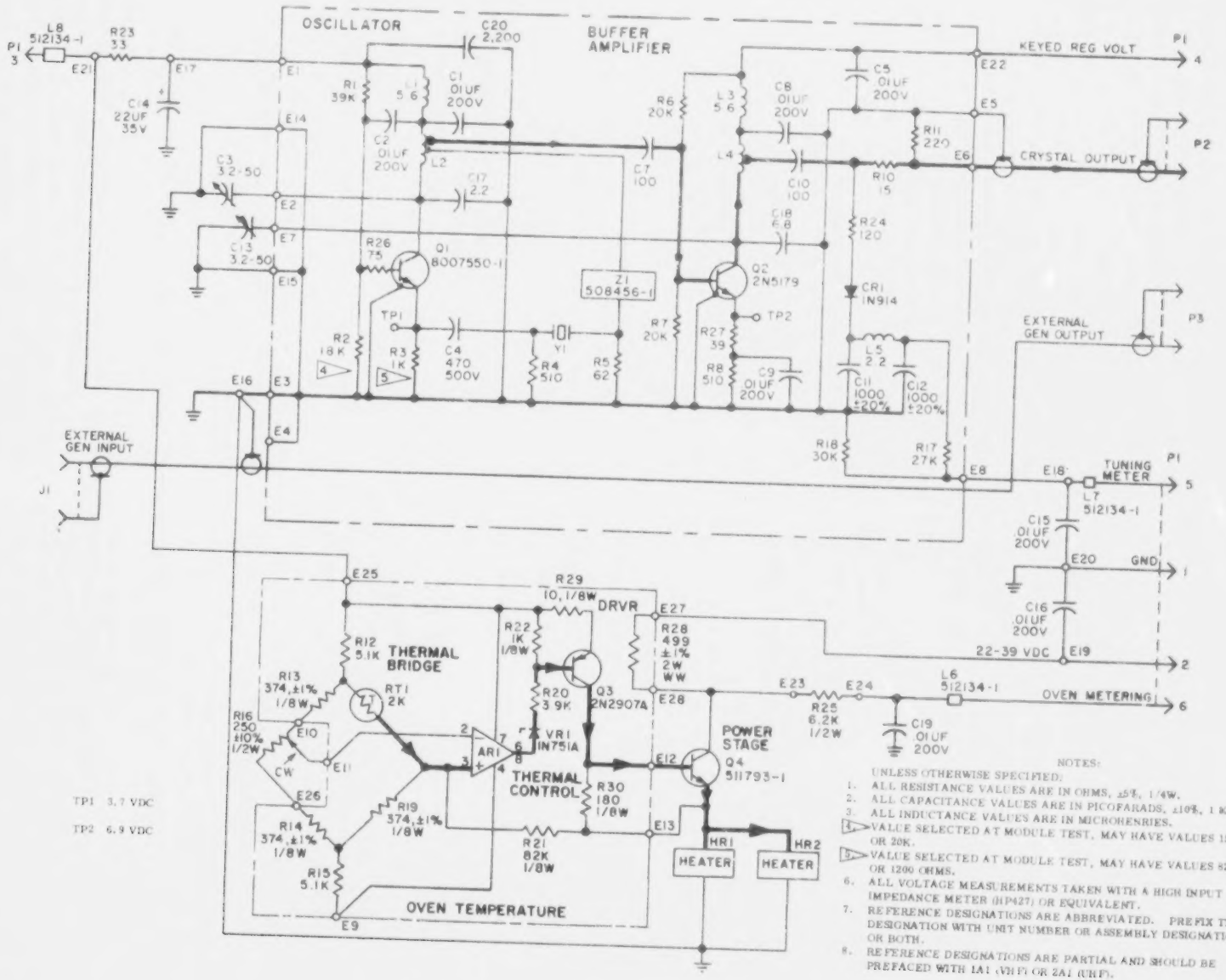
b. The voltage at gate 2 of Q1 is developed from the age input to the module. The age input is divided by R1 and R2 and applied to the base of common emitter amplifier stage Q3. The age input is also connected through L15 and PIN diode CR4 to voltage divider R29 and R30. As the age voltage level increases with increasing rf signal level, the PIN diode is driven into conduction and thus attenuates incoming signals and prevents Q1 and Q2 from being overdriven. The collector of Q3 becomes less positive as the input age level becomes more positive. This voltage is a bias voltage direct coupled to gate 2 of Q1 after being level changed by Zener diode VR2, allowing the age input to control the level of the rf signal through Q1. The output at the drain of Q1 is coupled through R38 and C7 to parallel tuned circuit L3 and C9. Resistor R38 is selected for module gain. Capacitor C9 is adjustable to peak up the signal at the received radio frequency. The signal is then coupled through C10 to gate 1 of dual-gate field effect transistor mixer stage Q2. The doubled crystal oscillator frequency is applied to gate 2 of Q2 and the intermediate frequency of 20.6 MHz is produced at the drain of Q2. Variable capacitor C41 is adjusted for maximum output at the if. signal. Impedance matching for the output circuit is provided by matching network L5, C18, C41, and C42. Temperature compensation is provided by thermistor RT3 and R36. The if. signal is also detected by CR1 and applied through R15 to the receiver front panel major test point MIXER OUT as a positive voltage level.

c. The output from the oscillator module is coupled through C21 to the base of doubler stage Q4. This signal is 0.6 to 1.0 volt rms. Approximately a +0.6-volt bias voltage is applied through R31 to the base of Q4. Capacitor C24 is adjusted to peak up the signal in the collector of Q4 at twice the signal frequency impressed upon the base. This doubled frequency is induced from L9 into L10 and coupled through C25 to the emitter of buffer amplifier stage Q5. A feedback loop from Q6 establishes the voltage level on the base of Q5, thereby controlling the emitter-base bias of Q5 and stabilizing its output. Capacitor C29 is adjustable to resonate at the frequency produced by the preceding doubler stage. This output is coupled through C33 and C11 to gate 2 of mixer stage Q2 as previously discussed. The output is also detected by CR3 and applied through a low pass pi filter and R27 to the base of Q6. Resistor R26 provides level control by controlling the feedback voltage to Q5; temperature compensation is provided by RT2. The detected and filtered output is also applied through R28 to the receiver front panel MULT test point.

5-10. UHF Receiver Mixer-Multiplier Module (2A2)

(fig. FO-2)

a. The UHF receiver mixer/multiplier module consists of an age-controlled rf stage, a mixer stage, a local oscillator frequency guadrupler stage, a buffer amplifier stage, an amplifier stage, a feedback amplifier stage and a series regulating stage for gain control. The rf input from the antenna is directly coupled to a tap on L10. The input tuned circuit consists of L10 and variable capacitor C30 which is peaked at the incom-



NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTANCE VALUES ARE IN OHMS, ±5%, 1/4W.
2. ALL CAPACITANCE VALUES ARE IN PICOFARADS, ±10%, 1 KV.
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
4. VALUE SELECTED AT MODULE TEST, MAY HAVE VALUES 15K OR 20K.
5. VALUE SELECTED AT MODULE TEST, MAY HAVE VALUES 820 OR 1200 OHMS.
6. ALL VOLTAGE MEASUREMENTS TAKEN WITH A HIGH INPUT IMPEDANCE METER (HP427) OR EQUIVALENT.
7. REFERENCE DESIGNATIONS ARE ABBREVIATED. PREFIX THE DESIGNATION WITH UNIT NUMBER OR ASSEMBLY DESIGNATION OR BOTH.
8. REFERENCE DESIGNATIONS ARE PARTIAL AND SHOULD BE PREFACED WITH 1A1 (VHF) OR 2A1 (UHF).

Figure 5-2. VHF/UHF receiver oscillator module (A1), schematic diagram.

EL5820-405-14-TM-32 C1

ing radio frequency. The input rf signal is coupled through C31 to gate 1 of the dual-gate field effect transistor rf stage Q7. The source of Q7 is supplied through R23 from the cathode of Zener diode VR1.

b. The voltage at gate 2 of Q7 is developed by the voltage divider consisting of R28, VR2 and R27 and is supplied to gate 2 of Q7 through R21 and L18. The agc input is divided by R18 and R19 and applied to the base of common emitter amplifier stage Q6. The agc input is also connected through L15 and PIN diode CR5 to voltage divider R38 and R39. As the agc voltage level increases with increasing rf signal level, the PIN diode is driven into conduction and thus attenuates incoming signals and prevents Q7 and Q8 from being overdriven. As the agc voltage increases, Q6 is driven harder into conduction and reduces the voltage supplied to gate 2 of Q7 by shunting VR2 and R27 in the voltage divider that provides bias for gate 2 of Q7.

c. The output at the drain of Q7 is coupled through C49 to parallel-tuned circuit L12 and C35. Capacitor C35 is adjustable to peak the signal at the received radio frequency. The signal is then coupled through C54 to gate 1 of the dual-gate field effect transistor mixer stage Q8. The quadrupled crystal oscillator frequency is applied to gate 2 of Q8 and the intermediate frequency of 20.6 MHz is produced at the drain of Q8. Variable capacitor C39 is adjusted for maximum if. signal output. Impedance matching for the ouput circuit of Q8 is provided by matching network C38, C39, L13 and C40. Temperature compensation is provided by thermistor RT1 and R45. The if. signal is also detected by CR4 and applied through R37 to the receiver front panel major test point MIXER OUT as a positive voltage level.

d. The output from the oscillator module is coupled through C1 to the base of quadrupler Q1. Bias for Q1 is supplied through R44 from voltage divider R1 and R2. Capacitor C12 is adjusted to peak the signal in the collector of Q1 at four times the frequency applied to the base. The quadrupled frequency is coupled through C16 on the emitter of common base buffer amplifier Q2. Capacitor C11 is adjusted to peak the signal at the collector of Q2 at four times the oscillator frequency. The signal is coupled through C17 to the base of amplifier Q3. Capacitor C27 is adjusted to peak the signal at the collector of Q3 at four times the oscillator frequency. The signal is coupled from the collector of Q3 through C23, C36, and L16 to gate 2 of Q8. The voltage at the collector of Q3 is also detected by CR1 and applied through L9 and potentiometer R17 to the base of feedback amplifier Q4. The collector voltage of Q4 in turn controls the base to emitter bias for series regulator Q5. Amplifier Q2 operates between cutoff

NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTANCE VALUES ARE IN OHMS ± 5%, 1/4 WATT.
2. ALL CAPACITANCE VALUES ARE IN PICOFARADS ± 20%, 500 VOLTS.
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

▷ HEWLETT-PACKARD 5082-8906

▷ RCA 2N5109

6. ALL REFERENCE DESIGNATIONS ARE PARTIAL AND SHOULD BE PREFACED WITH (A5(VHF) OR 2A5(UHF)

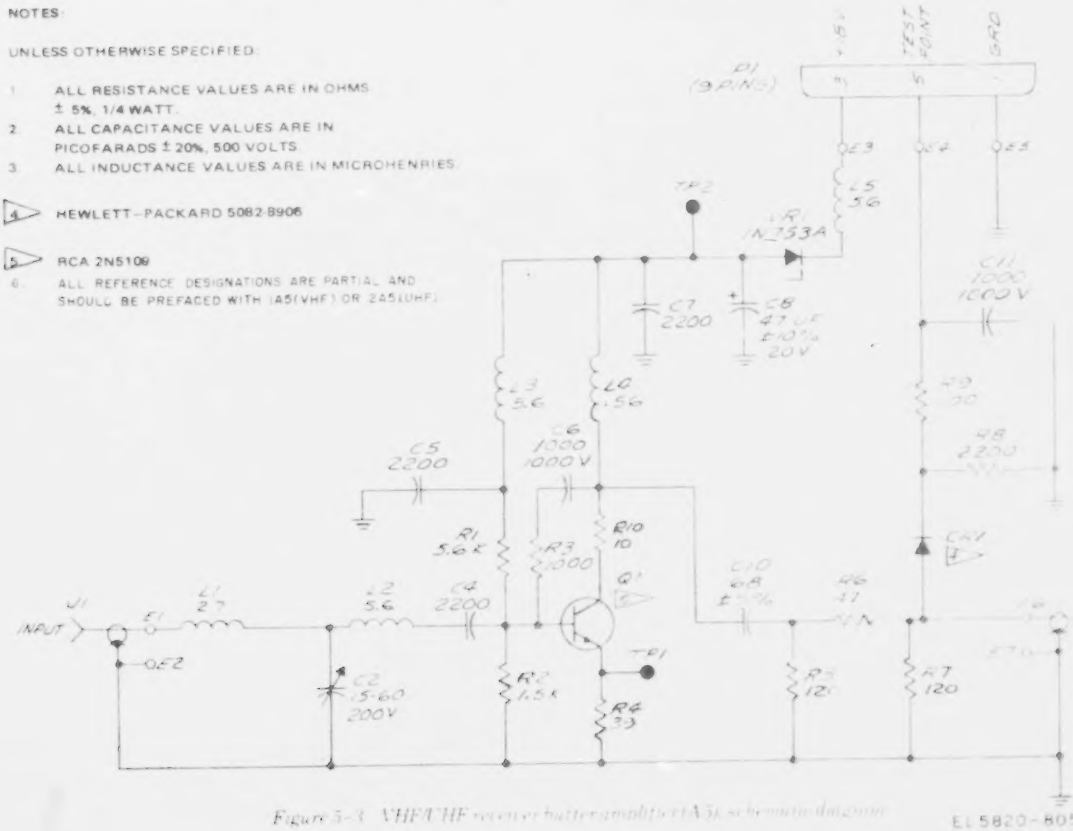


Figure 5-3. VHF/UHF receiver buffer amplifier A5 schematic diagram

EL 5820-805-14-TM 19

and saturation. Amplifier Q5 controls the output of Q2 by controlling the dc supply voltage to Q2 and thus the operating point Q2. The detected voltage from CR1 is also applied to the front panel major test point MULT.

5-11. VHF/UHF Receiver Buffer Amplifier (A5)

(fig. 5-3)

a. The function of the buffer amplifier is to provide a 50-ohm source impedance for the crystal filter and approximately a 50-ohm load to the mixer-multiplier module. The operating frequency is 20.6 MHz. The module gain is 0 ±1 db and its 3-db bandwidth is about 4 MHz. The tunable capacitance (C2) is adjusted for maximum gain at 20.6 MHz when J1 is fed from a 50-ohm generator and P1 is loaded with 50 ohms. The +18 vdc supplied to the module is zenered down to about 12 vdc by VR1, a 6.2-volt Zener diode. Inductor L5 prevents rf from leaving the module on the 18 vdc line, and C7 and C8 provide a low ac impedance to keep the signal off the 12 vdc line.

b. Inductors L1 and L2 and capacitor C2 are the input matching network. Resistors R1 and R2 bias Q1 so that its collector current is about 35 ma. Inductor L3 and capacitor C5 prevent any residual rf that may be on the 12 vdc line from appearing at the base of Q1. Both R4 and the series combination of R3 and C6 provide degenerative feedback for the amplifier, making it stable and allowing interchangeability of transistors without gain change. Inductor L4 is the collector load. Capacitor C10 accomplishes impedance step-down from the collector impedance to the 50-ohm impedance of the 7.5-db pad (R5, R6, and R7). Resistor R10 suppresses any tendency toward high frequency oscillations. When the signal at the output (P2) is large enough (greater than 0.5 vrms), CR1 rectifies a portion of the signal and C11 filters it to give a dc indication on the condition of the module at the NOISE LIM test point at the front panel of the receiver.

5-12. VHF/UHF Receiver Optional Noise Limiter (A5)
(fig FO-3)

a. The signal applied to noise limiter module input J1 flows through an amplifier, a 0.2-μsec delay line, and a gating circuit to output connector P2 with unity gain. See figure FO-3. The same signal applied to the input also flows into a circuit which establishes a dc voltage directly proportional to the amplitude of the intermediate frequency signal. If a pulse of noise occurs which is from 20 to 30 db higher than the signal voltage, the gate is closed and the output signal is momentarily cut off. A pulse stretching effect occurs in this second loop so that the output signal is gated off for a slightly longer time period than that occupied by the noise pulse. This is to allow complete blanking of the noise pulse. These signal blank-out periods are of such short duration that they cause no adverse effect on the audio signal at the receiver output.

b. The intermediate frequency input of J1 is applied through an impedance matching network to the base of amplifier stage Q1. Capacitors C2 and C5 are adjustable to obtain the best impedance match between 50-ohm input J1 and the amplifier input. Amplifier Q1 boosts the signal level to compensate for signal degradation in delay line DL1 and following circuitry thereby maintaining a net gain of 1 for the module. The signal is coupled from the collector of Q1 to the 0.2-μsec delay line by C8 and C9. Capacitors C8 and C10 are adjustable for an impedance match with the 50-ohm delay line input impedance. The output of DL1 is applied through a PIN diode gate made up of CR3 and CR4 to module output connector P2. Normally, with no noise pulse present, CR3 and CR4 are forward biased, presenting minimum impedance to signal flow to module output connector P2.

c. The signal input at J1 is also applied to the gate control loop consisting of an intermediate frequency amplifier, a detector, an agc feedback loop, a pulse amplifier, and a gate driver. Amplifiers Z1 and Z2 are integrated circuit intermediate frequency amplifiers. These amplifiers are broadband tuned as a result of discrete components external to the integrated circuits. Amplifier Z1 receives an agc input at pin 2. Amplifier stage Q5 is tuned to the intermediate frequency of 20.6 MHz by C38. The collector of Q5 is coupled to the input of integrated circuit Z3 at pin 9. Amplifier Z3 contains a detector, an agc output, and a pulse amplifier. The agc level is adjusted by R44 and is fed back from Z3 pin 5 to Z1 pin 2. Temperature compensation is provided by CR6, CR7, and CR10.

d. The detected signal, along with any noise that might be present, is clamped above ground level through the action of CR8 and applied to the base of emitter follower Q7. The signal from the emitter of Q7 is then applied through R63 and R64 to the base of Q10. However, the signal at the junction of R63 and R64 is clamped below a variable voltage level dependent upon the average peak signal. The agc from Z3 pin 5 is also applied through R72 to the base of Q6, allowing C46 to charge up to a value representing the level positive excursion of the detected signal. The base of Q10 is clamped below that level through the action of CR9. When a noise spike occurs extending more positive than the average signal level, it passes through emitter follower Q10 and is amplified by pulse amplifier Q8 and Q9. The noise spike is then coupled through C12 to the base of Q2. The action of CR1, R12, C15, R13, and C14 stretches and couples the pulse to the base of Q3. Amplifier Q3 cuts off for the duration of the pulse and Q4 goes into conduction, applying +12 volts to the cathode of PIN diode gate CR3 via R20 and L5. Diodes CR3 and CR4 are then back-biased for a time slightly longer than the duration of the noise pulse (+6 volts is applied to the anode of CR4 via R27 and L6) and the noise pulse is effectively removed from the receiver output.

c. At the end of the noise blanking pulse, Q3 resumes normal conduction and Q4 is cut off. This effectively connects the cathode of PIN diode gate CR3 to ground via L5, R20, CR2, Q3, and R16 thus supplies forward bias to the PIN diodes opening the gate. The +18 volts on P1-3 is decreased to +6 volts and +12 volts for use within the noise limiter module. The +6 volts is supplied by regulator circuit R28, VR1, C26, and R29; and +12 volts is supplied by regulator circuit Q11, R33, R34, VR2, and C49. The module signal output is also detected by diode CR5 and applied to receiver front panel major test point NOISE LIM.

5-13. VHF/UHF Receiver Bandpass Crystal Filter (FL1)

The bandpass crystal filter has a center frequency of 20.6 MHz which establishes the receiver selectivity. Ultimate rejection is 100 db at 20.6 MHz ±300 kHz. Rejection is 6 db or less at 20.6 MHz ±18 kHz. Insertion loss is 4 db maximum; ripple across the band at 20.6 MHz ±15 kHz is 1 db or less, and the input-output impedance is 50 ohms.

5-14. VHF/UHF Receiver Intermediate Frequency Amplifier and Detector (A6)

(fig. FO-4)

a. The intermediate frequency amplifier consists of four cascaded common-emitter intermediate frequency stages followed by a detector and a low gain intermediate frequency stage base drive by the fourth stage. Low gain intermediate frequency stage Q5 is an isolation amplifier whose output is coupled through J2 to 50-ohm output connector J10 on the receiver rear panel. Detector Q6 is biased to perform the detection function and provide an audio signal to the audio preamplifier agc/squelch module. The detector also drives wideband audio amplifier Q7 and associated circuit components. First amplifier Q1 is a common-emitter configuration driven by the input intermediate frequency signal through matching network C1, C2, C3, and L1. Capacitors C2 and C3 are provided to adjust the input impedance of the first stage to 50 ohms. The gain of this stage is controlled in a forward agc mode through base bias resistor R2. The agc voltage controls the base drive through L2 and CR1. Resistor R1 and CR2 provide a fixed current to the bias network to maintain a high gain in the transistor in the absence of agc voltage.

b. The second and third stages, Q2 and Q3, are identical common-emitter stages driven in cascade by the first stage. The gain of each stage is controlled in a reverse agc mode by the injection of an agc voltage to the emitters of the transistors. The agc voltage is applied to the emitter of Q2 through R12, L9, and CR3. The agc voltage is applied to the emitter of Q3 through R15, L10, and CR4. The fourth stage, Q4, is a common-emitter stage, having no automatic gain control, which drives both the detector and the 50-ohm output isolation amplifier. Isolation amplifier Q5 is a low-gain, common-emitter stage which drives the 50-ohm output connector through a matching "T" network composed of R23, R24, and R25. The detector stage, Q6, uses its base-emitter junction to rectify the intermediate frequency signal. Capacitors C38 and C43 and resistor R37 filter out the intermediate frequency signal components and apply the filtered audio to the output connector. Capacitor C39 couples the audio signal to the wideband audio amplifier which uses Q7 in a common-emitter output stage. The wideband amplifier has a 25-kHz passband.

5-15. VHF/UHF Receiver Preamplifier/ Agc-Squelch (A3)

(fig. FO-5)

a. General. This module consists of an audio preamplifier, agc amplifier, squelch and compression circuits. This module contains circuits for the reduction of unwanted noise associated with carrier attacks, squelch release, compression set, squelch attack and squelch quieting. Further, the module provides relief from the annoying and distracting sounds arising from these causes. It also has a high ON-OFF squelch ratio, audio frequency compression at any audio output level setting, decreased squelch hysteresis and rejection of pulse noise when the receiver is squelched. (See figure FO-5).

b. Preamplifier, Audio Frequency and Squelch Circuits. The audio input comes into P1 through pin 12 and is coupled through C4 to a limiter consisting of diodes CR3, CR4, and CR8. This limiter is used to clip unwanted noise and transient spikes that occur in the audio input. The audio signal is then coupled through the voltage divider network consisting of R31 and R32, through capacitors C5 to the compression control FET Q7. The audio signal is fed through Q7, through capacitor C6 to the audio amplifier Q8. Q8 amplifies the audio signal, coupling the amplified signal through C9 to amplifier Q10. Q10 further amplifies the audio signal and couples the output to a floating limiter consisting of CR6, CR7, R55, C12, and C13. This floating limiter provides limiting action around the d-c bias level and provides further limiting of unwanted noise pulses that occur in the radio passband. At this point in the circuit, the audio is compressed and maintains a near constant peak-to-peak signal level and the floating limiter limits at levels just above and

below the compression peak-to-peak audio level. The signal is then coupled through squelch control FET Q11 (described later) to emitter follower Q12. The output from Q12 is then coupled through the low pass filter amplifier circuit consisting of R60, C15, R61, C17, R62, and C16 to operational amplifier U2. The output from the low pass filter network is coupled through C18 to a high pass filter network consisting of C18, C19, R65, R66, C20, R67, R68, Q13, Q14, R69, R70, and R71. The tandem connection of the low pass filter and the high pass filter provides a receiver band pass characteristic that passes 300 to 3000 Hz within +1 to —2 db of the reference frequency of 1000 Hz. The band pass of this filter rolls off the low end to at least 10 db down at 100 Hz and at least 10 db down at 10,000 Hz.

c. Audio Compression Circuit. The audio output from the preamplifier path is coupled back to an amplifier consisting of transistor Q9 and associated biasing components. This stage amplifes the radio, detects and provides a d-c bias to the compression FET Q7. Adjustment of the compression level is accomplished by an adjustment of R41 potentiometer which controls the amount of compression and the signal level output. This feedback compression circuit maintains a constant audio level output with varying audio input signals. The audio output from this module is coupled to the gain control on the front panel; consequently all compression takes place before the main audio gain control, thus compression is obtained at any audio signal level output. The compression detection takes place in diode CR5, and any ripple is filtered out by capacitor C7. This provides d-c bias that is proportional to the audio level to the FET gate through resistors R73 and R34.

d. Squelch Gate. FET Q11 provides a series squelch switching action that turns the audio output on and off as a function of the age amplifier. When the gate control voltage to Q11 is biased to a turn-off point, no audio signals pass through Q11. The source and the drain voltage potentials are nearly the same, thus providing no d-c level shift when the transistor is turned off. When the transistor is turned on, the audio signal proceeds through Q11 with very little attenuation. It is the equipotential source and drain voltages that provide the quiet switching action of this squelch switch.

e. AGC Amplifier. The automatic gain control amplifier consists of a differential amplifier, an emitter follower amplifier stage and two additional amplifier stages. The detected carrier is coupled through R30 to the base of differential amplifier stage Q1. This transistor shares an emitter load network with Q2 consisting of R2, R3, and R5. The operating level of Q2 is adjusted by variable resistor R7. The voltage at the junction of R6 and R9 is regulated by zener diode VR1. R11, RT1, and R10 are for temperature compensation. The adustable voltage applied to the base of Q2 is established by the voltage divider composed of R6, R7, and R8. Direct coupling is used throughout the age amplifier. The output from the differential amplifier, the collector of Q2, is applied to the base of emitter follower stage Q3. CR1 is used for temperature compensation. The Vcc for the first three transistors is regulated at approximately +12 volts through the action of zener diode VR2 and R13. Emitter follower Q3 output is applied to the base of Q4. The collector of Q4 is connected directly to the base of Q5. The automatic gain control output is taken from the collector of Q5. This output is also applied through R18 to the receiver front panel major AGC test point, and to the squelch circuit (located in this same module) via R19 and the receiver front panel squelch control potentiometer.

f. Squelch. The squelch circuit is essentially an electronic switch which turns on the preamplifier squelch FET when the detected signal reaches a certain level and turns off the FET when the detected signal is reduced to a certain level. With the receiver front panel squelch switch in the on position, the age voltage is applied across R19, the front panel squelch screw-driver adjust R1 and R28. The wiper of the front panel control R1 is directly coupled through resistor R23 to pin 3 of the operational amplifier U1. If the detected r-f level increases, the output from operational amplifier pin 6 goes positive and turns on the squelch FET Q11 in the preamplifier circuitry. If the detector r-f level decreases, (as indicated by a decrease of the age level) to the squelch level, the output from operational amplifier U1 decreases thus turning off the squelch FET Q11 in the preamplifier circuitry. Complete and rapid switching is insured by the feedback path resistor R22 around the operational amplifier U1. Diode CR2 provides fast decay of the squelch switch filtering capacitor C14 when the squelch switch turns off. When the receiver unsquelches, resistor R24 provides a short time constant action to charge C14 so that a small squelch delay occurs to provide inhibiting of any unwanted transients at the time of initial detection of input signals. Transistor Q6 provides a monitor output drive and serves as an isolation transistor for the squelch test point.

5-16. VHF/UHF Receiver Audiofrequency Amplifier (A4)

(fig. FO-6)

a. General. The audiofrequency amplifier consists of two separate audio amplifier systems. The main audio amplifier receives an input signal controlled by the AUDIO MAIN ADJ screwdriver adjustment on the receiver front panel and supplies an output to a connector on the receiver rear apron for remote speaker operation. The secondary audio amplifier receives an input controlled by the PHONE ADJ control on the receiver front panel and supplies an output to the PHONE OUTPUT jack on the receiver front panel.

b. Main Audio Amplifier. The main audio amplifier consists of a common-emitter amplifier stage, a phase-splitter stage, a push-pull driver stage, a push-pull output stage, and an output transformer. The input audio signal is coupled through C1 and R16 to the base of common-emitter amplifier stage Q5. Degenerative feedback to this stage is employed to provide adequate regulation of the output signal voltage. This negative feedback signal is derived from output stage Q3 and is also coupled to the base of Q5 via R24 and C11. The signal from the collector of Q5 is coupled through C2 to the base of phase splitter Q6. The phase splitter provides signals of equal magnitude and opposite polarity to the output driver stage consisting of Q1 and Q2. Temperature compensation of bias for the driver stage is provided by CR2 and CR3. The output signal from the emitters of driver stage Q1 and Q2 is direct-coupled to the pushpull output stage at the base of Q3 and Q4. The collectors of Q3 and Q4 are connected to the primary of output transformer T1. The center tapped secondary of T1 is connected to a rear apron connector on the receiver. Signal voltage across T1 is limited to approximately 43 volts peak to peak maximum by the action of Zener diodes VR1 and VR2. A compression output to the audio preamplifier/agc squelch module is provided from the collector of Q3. The signal from the collector of Q4 is divided by R46 and R47 and coupled through C24 to the receiver front panel major test point MAIN AF.

c. Secondary Audio Amplifier. The secondary audio amplifier consists of a common-emitter amplifier stage, a phase splitter, a push-pull output stage, and an output transformer. The input audio signal is coupled through R25 and C13 to the base of common-emitter amplifier stage Q7. Degenerative feedback from the collector of Q9 is also coupled to the base of Q7 via C14 and R26. The signal is coupled from the collector of Q7 through C19 to the base of phase splitter stage Q8. High frequencies are attenuated through the action of C20 and R37. Amplifier Q8 provides signals of equal magnitude and opposite polarity to the push-pull output stage consisting of Q9 and Q10. This stage drives output transformer T2. The voltage across the primary of T2 is limited to a maximum of approximately 43 volts peak-to-peak by the action of Zener diodes VR3 and VR4.

d. Surge Protection. Surge protectors are provided to protect the audio amplifier output circuits from ±1000-volt peak input pulses applied to each audio output. Protection for the main audio amplifier output is provided by surge protectors E1 and E2. These are mounted on terminal board TB1 adjacent to rear apron connector J2. Protection for the secondary audio amplifier is provided by E8 mounted on the back of the receiver front panel PHONE OUTPUT jack.

5-17. VHF/UHF Receiver Power Supply (PS1)

(fig. FO-7)

a. General. The power supply consists of a power transformer, a bridge rectifier, a voltage regulating circuit, a battery charging circuit, and a short circuit protection circuit. The power supply is designed to operate from either ac or dc voltages. Jumpers are provided on terminal board TB1 to allow the power supply to operate at any one of the following primary voltages: 105, 120, 210, or 240 vac ±10%. Usable frequency for primary ac power is 47 to 420 Hz. In case of ac power failure, primary power is supplied to the power supply from an external battery. With the supply operating on ac, voltage is applied to the primary of transformer T1 via TB1. The secondary of T1 connects to bridge rectifier CR1, CR2, CR3, and CR4. An unregulated output of approximately +30 volts is provided at the junction of CR1 and CR2 for use as crystal oven heater power for the oscillator module. This same output flows through R2 and is reduced to +18 volts ±0.5% by series-pass transistor Q3 to supply the regulated voltage required by the receiver.

b. Regulator Circuit. Amplifiers Q6 and Q7 form a differential amplfier emitter resistor R15. The regulator output voltage is applied across voltage divider R16, R17, and R18. A sample of the output, from potentiometer R17, is applied to the base of Q7. The level of the output voltage may be set by adjusting R17. A reference voltage established by zener diode VR2 is applied to the base of Q6 which is the other differential amplifier input. The output of the collector of Q7 is direct-coupled to the base of common-emitter amplifier stage Q5. The voltage at the emitter of Q5 is held at a constant value by VR1. A second input to the base

of Q5 is applied by the short circuit protection circuit via CR5. When the supply is operating with no short circuit present, CR5 will be back-biased effectively, disconnecting the short circuit protection input from the base of Q5. The output of amplifier stage Q5, at the junction of resistors R9 and R6, is direct-coupled to the base of common-emitter amplifier stage Q2. The collector of Q2 is direct-coupled to the base of series-pass transistor Q3. The amplitude and polarity of this signal is such that a regulated +18 volts is produced at the emitter of Q3. Special circuitry is necessary to facilitate the start up of the regulator. When power is turned on, capacitor C3 is charged up through resistor R7. The junction of R7 and C3 is connected to the base of Q5 through R8. When the voltage applied to the base of Q5 becomes positive enough, it overcomes the positive emitter voltage established by VR1, and Q5 begins to conduct through R9 and R6. Current through R6 causes Q2 to start conduction which, in turn, allows conduction through series-pass transistor Q3. When sufficient current flows on the regulated +18-volt line, the normal regulater takes control and the output is maintained at +18 volts. The relatively large value of R8 sufficiently isolates the startup circuit to allow Q5 to be controlled by differential amplifier Q6 and Q7 when these transistors receive adequate operating voltage.

c. Battery Charging Circuit. The battery is charged by a 300-ma nominal constant-current source when the power supply is operating from ac. The battery charge path is from the junction of CR1 and CR2 through R22 and R23, Q8 and CR9 to the battery bus. Transistor Q8 is the series-pass transistor in the charging circuit. A constant voltage is applied to the base of Q8. This constant voltage is established by the voltage dropped across forward-biased diode string CR6, CR7, and CR8 (approximately 2 volts is dropped across the diodes). The charging current through emitter resistors R22 and R23 determines the emitter-base bias in Q8 and maintains the 300-ma nomial trickle charge rate. Reverse battery polarity protection is provided by stage Q9. With proper battery polarity, Q9 is in the cutoff region. However, if the battery is connected backward, a negative voltage will be applied to the base of Q9, causing heavy conduction. This eliminates the 2 volts dropped across diodes CR6, CR7, and CR8 and applies a back emitter-base bias to series-pass transistor Q8. Transistor Q8 is then driven into the cutoff region and the battery charge path is interrupted.

d. Short Circuit Protection. When a short circuit occurs, a heavy current tends to flow through R2, in series with series-pass transistor Q3. An increase in current flow also occurs in R1 and R3. A forward emitter-base bias for Q1 is developed across R1, and Q1 starts to conduct. This applies forward bias to the emitter-base junction of Q4 which begins to conduct through R5. The collector of Q4 is connected through CR5 to the base of Q5, driving it into cutoff. Q5 is an amplifier stage in the regulator circuitry discussed in a previous paragraph. As a result of the regulator action, series-pass transistor Q3 is cut off, thus removing the power supply regulated output from the receiver modules. Capacitor C2 across the emitter-base junction of Q1 prevents extraneous activation of the short circuit protection as a result of momentary changes in load. The short circuit protection circuit is latching and, once triggered by an overload, the regulated output is not reapplied until the receiver is turned off and then on again. Once an overload has occurred, current flows through Q4, R5, and R1 Current through R1 holds Q1 conducting which, in turn, maintains a forward bias on Q4 and holds it in conduction until primary power has been removed from the power supply.

e. Ac Power Failure. In case of ac power failure, primary power will be supplied from the battery. Current flow will be from the battery bus through isolation diode CR10, R2, and series-pass transistor Q3 to all receiver modules requiring regulated voltage. The same regulator circuit is used regardless of whether using an ac or a dc power source.

CHAPTER 6

DIRECTION SUPPORT MAINTENANCE INSTRUCTIONS

Section I. GENERAL

6-1. General

a. Scope and Organization. This chapter contains information and instructions for direct support personnel to troubleshoot, repair, align or tune, and checkout performance of both the VHF and UHF receivers. Section II provides troubleshooting instructions, section III provides repair instructions, and section IV describes when and how to align or tune the receiver after repair and gives instructions for checkout of receiver performance.

b. When to Call in General Support. Paragraph 6-3 describes the troubleshooting and repair process and at what point forwarding to general support is required. In addition, if a fault cannot be isolated or if repair procedures are not provided in section III, forward receiver to general support. Do not forward faulty modules to GS. Forward modules to US Air Force for depot repair.

c. Periodic Maintenance. Periodic maintenance at direct support shall consist of performing a performance checkout (sec. IV) monthly.

6-2. Tools and Test Equipment Required

Tools and test equipment required for direct support maintenance are as follows:

Tool Kit, Electronic Equipment TK-100/G.	5180-605-0079
Multimeter ME-26( )/U	6625-360-2493
Generator, Signal AN/USM-44( ).	6625-669-4031

Also required is a set of 600-ohm headphones.

Section II. DIRECT SUPPORT TROUBLESHOOTING

6-3. General

The procedure for troubleshooting the VHF or UHF receiver is as follows:

a. Perform preliminary operational tests in paragraph 6-4 and compare results with table 6-1 to localize the fault.

b. Measure voltages at test points on J15 on the inside of the front panel access door, compare with the values in table 6-2 and use table 6-3 to isolate the fault.

c. Proceed to section III for instructions on replacing the faulty module, using table 6-3. Replace module.

d. If replacement of module fails to correct fault, then proceed as indicated in table 6-4 for further troubleshooting. Further troubleshooting in the applicable table should pin the problem down to one of the other modules or to chassis components or wiring. If the indicated cause is a module, refer to section III for instructions on replacement. If the cause is a chassis component or wiring, remove the receiver from the rack and forward to general support for repair. Be sure to advise general support of the indicated cause of fault and the action required.

e. See figures 3-1, 3-2, and 3-3 for location of controls and indicators.

6-4. Preliminary Test

Prior to starting actual diagnosis of faults, perform the following:

a. Plug the headphones into the AUDIO OUTPUT jack on the front panel, and observe receiver performance on known signals.

b. Adjust the AUDIO PHONE ADJ gain control for a desired level. Disable the squelch if desired.

NOTE

Since the phone audio channel is separate from the main audio channel, faults in the main audio channel may not be observed by this method. It is also possible that unknown faults in the phone audio channel may be present.

c. Compare the audio heard with the audio that is expected.

d. Confirm, if possible, that the fault actually exists.

e. Based on these initial observations such as distorted audio, degraded sensitivity, etc, refer to table 6–1 for a most probable cause of the fault.

6–5. Isolation of Fault to Module Using Test Points on J15

a. Check the voltages between each of the test points listed in table 6–2 and the ground point (on J15 inside front panel access door). Be sure to comply with the required conditions under the *Signal input* column. Input signal is applied at the RECEIVER INPUT jack with the coaxial jumper removed. Use the signal generator specified in paragraph 6–2 or its equivalent. Use the multimeter specified in paragraph 6–2 for voltage measurements. Compare the voltage readings with the normal readings in table 6–2. Then refer to table 6–3 and compare results for troubleshooting procedure.

b. Be sure to observe the following precautions when making readings at the test points:

(1) When a test point appears to have an incorrect indication, verify that the multimeter is on the correct scale, and that the input signal levels are as expected.

(2) When a test point reading leads to some conclusion regarding the module which is faulty, verify all other related test point readings which would support that conclusion.

(3) Do not make adjustments to the receiver with undiagnosed faults present in the receiver, except as follows:

(*a*) Set AUDIO MAIN ADJ (R2, fig. 3–1) output level as desired.

(*b*) Set AUDIO PHONE ADJ (R3) output level as desired.

(*c*) Set SQUELCH (S1) to ON or OFF as desired.

(4) When agc performance, squelch threshold, audio output level, or sensitivity shows a significant degradation, do not attempt to restore normal condition through adjustment. (While such adjustment might seem correct or improve a condition noted, it will only mask the original symptoms, and make further diagnosis difficult.)

(5) Do not swing tuning controls through their range in an attempt to see if they respond.

(6) Do not swing tuning controls through their range if they have been misadjusted.

(7) Perform only those retuning and alignment adjustments indicated, and then only in connection with service restoration following replacement of a faulty module.

(8) Do not adjust the power supply. Adjustment to this module shall be made at depot maintenance category.

c. Set POWER ON–OFF switch to ON. This is the only preliminary control setting before use of table 6–2. For further instructions, note *Signal input* and *Comments* columns of table 6–2. Signal input is applied to RECEIVER IN-

Table 6–1. VHF–UHF Receiver Fault Localization Indications

Step	Symptom	Probable cause
1	No signal, only background noise	Oscillator A1; mixer-multiplier A2.
2	Degraded sensitivity, high background noise	Mixer-multiplier A2, oscillator A1.
3	Degraded sensitivity, medium background noise	Noise limiter A5; if. amplifier A6.
4	Degraded sensitivity, low background noise	If. amplifier A6; agc/squelch A3.
5	No signal, no noise	Power supply PS1; audio amplifier A4; agc/squelch A3.
6	High impulse noise level (static)	Noise limiter A5.
7	Distorted audio	Audio amplifier A4; agc/squelch A3; if. amplifier A6.
8	Ac hum in audio	Power supply PS1
9	Excessively high audio, with distortion	Agc/squelch A3, audio amplifier A4.
10	No main af output, phone	Audio amplifier A4; agc/squelch A3.
11	No phone audio output. Main af output OK	Audio amplifier A4; agc/squelch A3.
12	Receiver off frequency	Crystal Y1 or oscillator A1.

Table 6-2. Normal Front Panel Test Point Indications

Step	Test point	Function	Signal input	Indication	Comments
1	UNREG B+	Measures output voltage of power supply full-wave rectifier.	Any	*a.* 27 vdc to 40 vdc	When primary power is ac. Voltage varies with line voltage.
				b. 21.5 vdc to 29.5 vdc	When primary power is a 24-volt battery.
2	REG B+	Measures output voltage of power supply regulator.	Any	17.4 vdc to 18.6 vdc.	
3	AGC	Measures output voltage on agc bus.	*a.* No signal (SQUELCH switch OFF).	2.6 vdc to 3.2 vdc.	
			b. No signal (SQUELCH switch ON).	1.5 vdc to 2.5 vdc.	
			c. −102 dbm	5 vdc minimum.	
			d. 0 dbm	9 vdc to 10 vdc.	
4	SQUELCH	Measures squelch control	*a.* No signal (SQUELCH switch OFF).	3 vdc to 9 vdc	
			b. No signal (SQUELCH switch ON).	Less than 1 vdc.	
			Note. Unless otherwise specified, SQUELCH switch should be at OFF.		
5	IF	Measures ac and dc voltage at output of detector stage.	*a.* No signal	2.5 vdc to 3.0 vdc.	
			b. Any level from −97 dbm to +13 dbm.	3.0 vdc to 5.0 vdc	As the generator power level is increased from −120 dbm to −97 dbm, this voltage will rise to some value within the indicated range. From −97 dbm to +12 dbm, the voltage will be almost constant, increasing only about 0.1 volt.
			c. −97 dbm to +12 dbm modulated 30 percent at 1 kHz.	50 mvac to 300 mvac.	
6	LO	Measures rectified rf output of oscillator module.	Any	0.25 vdc to 0.8 vdc.	
7	MULT	Measures rectified rf output of multiplier.	Any.		
				a. VHF 0.95 vdc to 1.07 vdc (See table 2-2 for exact level.)	Exact level is set during tuning. With LEVEL ADJ potentiometer maximum clockwise during tuning, indicator will be 1.3 v to 2.0 v.

TM 11-5820-805-14

Change 1

Step	Test point	Function	Signal input	Indication	Comments
				b. UHF 2.0 vdc to 4.0 vdc (See table 2-3 for exact level.)	Exact level is set during tuning. With LEVEL ADJ potentiometer maximum clockwise during tuning, indicator will be 5.5 v to 20 v.
8	LO. OVEN	Measures voltage across resistor in series with oscillator oven heater. CAUTION A grounded case voltmeter shall not be used to measure L.O. oven voltage. Use of this type voltmeter may cause damage to the crystal controlled oscillator (A1).	Any	See *Comments* column	Connect positive terminal of voltmeter to UN-REG B+ and negative terminal to LO OVEN. The observed indication will be a voltage across the metering resistor of .499 ohms. This voltage at initial equipment turn on will be .4 ±.1 volt and indicates maximum heat demand by the oven. With minimum heat demand the reading will be .1 ±.05 volts. The metering voltage may be zero in very high ambient temperature.
9	MIXER OUT (UHF and VHF).	Measures rectified if. voltage at output of mixer.	+10 dbm (See Comments column.)	0.2 vdc or greater	Adjust the generator frequency slightly off-channel for maximum indication. (This disables the age and permits a usable indication.)
10	NOISE Lim. (This monitors equivalent test point in buffer amplifier.)	Measures rectified if. voltage at output of limiter.	+10 dbm (See Comments column.)	0.2 vdc or greater	Adjust the generator frequency slightly off-channel for maximum indication. (This disables the age and permits a usable indication.)
11	AF PREAMP	Measures ac voltage at output of af preamplifier.	−97.5 dbm to +13 dbm, 30 percent modulation at 1 kHz. AUDIO MAIN ADJ potentiometer maximum counterclockwise.	0.3 vac to 1.0 vac typical	Actual level varies with setting of R32 on AGC/squelch module.
12	MAIN AF	Measures sample of ac voltage at output of main audio amplifier.	−97.5 dbm to +13 dbm, 30 percent modulation at 1 kHz AUDIO MAIN ADJ potentiometer maximum clockwise.	1.5 vac to 2.5 vac.	

Table 6-3. Fault Isolation Using Test Point Indication

NOTES

1 If all test point indications are normal but receiver fails to receive signals when connected to antenna, refer direct to table 6-6.
2 If receiver is off frequency and LO and LO OVEN test points indicate normal, change crystal Y1.
3 Failures of the wideband data output and if. output functions of the receiver (when all oth r receiver functions are normal) are caused only by if. amplifier A6 or external wiring.

REG B+	AGC	SQUELCH	IF	LO	MULT	MIXER OUT	NOISE LIM	AF PREAMP	MAIN AF	HEAD PHONES	Probable cause
Low											Power supply PS1
High											Power supply PS1
OK	Low			Low							Oscillator A1
OK	Low			OK	Low						Mixer-multiplier A2
OK	Low				OK	Low					Mixer-multiplier A2
OK	Low				OK	High	Low				Noise limiter A5
OK	Low		OK		OK	High	High	Low			IF. A6
OK	Low		Low		OK	High	High	Low			IF. A6
OK	Low		High		OK	High	High	High		Distortion	Agc/squelch A3
OK	High		Low		OK			Low			Agc/squelch A3
OK	OK	Low			OK			Low			Agc/squelch A3
OK	OK	OK	OK		OK			Low			Agc/squelch A3
OK	OK				OK			OK	Low		Audio amplifier A4
OK	OK				OK				OK	Static	Noise limiter A5
OK	OK				OK				OK	Hum	Power supply PS1

PUT jack (J11) (BNC female receptacle) on receiver front panel. Frequency of input should be operating frequency of receiver. If modulation is not specified, none is required.

6-6. Further Troubleshooting if Module Replacement Fails to Correct Fault

a. After performing the troubleshooting procedures in the preceding paragraphs and replacing the module indicated by table 6-3, if the fault still exists, refer to table 6-4 for instructions on where to find further troubleshooting procedures.

b. When fault diagnosis indicates that agc is very low, and not responsive to high signal levels, with excessively high test point readings at MIXER OUT and NOISE LIM together with receiver overload and distorted audio, and replacement of agc/squelch module A3 does not correct the fault, the fault may be a shorted agc buss in an external module. Replace if. amplifier module A6. If this does not correct the faulty condition, replace mixer-multiplier module A2. If this does not correct the condition, check for a possible agc buss wire short. If agc voltage, as read at the AGC test point, is abnormally high but other test point readings indicate excessive signal, overload and distortion, the fault may be an open agc buss wire to the if. amplifier and/or mixer-multiplier module. Refer to GS for check of chassis wiring.

c. Most of the probable faults in the audio system will be in if. amplifier A6 or agc/squelch A3 modules. This includes loss or degradation of audio in either main or phone outputs, or excessive audio together with distortion or high audio levels due to a fault in the audio compression circuits. If replacement of the module indicated as the most probable cause does not correct the fault, replace the other module. If the fault is still present, refer to GS for check of chassis wiring.

Table 6-4. Further Troubleshooting Procedures

Module replaced	Ref designation	Further action
Oscillator	A1	Check crystal Y1, forward to GS for check of chassis wiring.
Multiplier-mixer	A2	Refer to table 6-6.
Agc/squelch	A3	Refer to paragraph 6-6*b*.
Audio amplifier buffer amplifier or optional noise limiter.	A4	Refer to paragraph 6-6*c*.
If. amplifier	A5	Refer to table 6-7.
Antenna coupler and external antenna connections	A6	Refer to table 6-8.
Power supply	A7	Refer to table 6-6.
Tunable filter	PS1	Refer to table 6-5.
Crystal filter	FL2	Refer to table 6-6.
	FL1	Refer to table 6-8.

Table 6–5. Power Supply PS1 Fault Analysis

NOTE

See table 6–2 for normal test point indications, and figures 3–1, 3–2, and 3–3 for location of controls, indicators, and test points.

WARNING

Use extreme care in performing the checks called for in notes 1, 3, 4, and 6 at the bottom of the table. The top cover must be removed to perform the check in note 6.

Type of operation	REG B+	UNREG B+	Ac on light	Blown fuse light	Ac voltage at fuses	Ac line voltage on input cable	Battery voltage	Battery terminal voltage	Probable cause
c operation only	Low	Low	On	Off	Low (note 1)				Low ac line voltage.
c operation only	Low	Low	Off	Off	Low (note 1)				Low ac line voltage.
c operation only	Zero	Zero	Off	On					Ac line fuse (2) F1 or F2 (fig. 3–1).
c operation only	Zero	Zero	Off	Off	OK (note 1)				Power ON–OFF switch S2 (note 8).
c operation only	Zero	Zero	Off	Off	Zero (note 1)	OK (3)			Ac line filter (connector/filter) (note 8).
c operation only	OK	OK						Low (note 5)	Power supply PS1 (note 7).
attery operation only	Zero	Zero					OK (note 4)		Power ON–OFF switch S2 (note 8).
attery operation only	Zero	Zero					Zero (note 4)	OK (note 5)	Dc line filter (connector/filter) (note 8).
attery operation only	Low	Low					Low (note 4)		Low battery voltage.
c and battery	Low	Low			Low		Low (note 4)		Both inputs low (note 7).
c or battery	Zero	OK							Short on reg B+ distribution bus, in some module (note 6).

NOTES

1 Ac line voltage may be measured at the fuseholders with caps and fuses removed; however, if other equipments in the installation are served by the same ac line and the basic line voltage is known to be correct, a quick check for the presence of ac voltage may be made by removing one of the fuses and reinstalling the fuse cap. Its indicating light will illuminate if ac voltage is present and the other fuse is intact.

2 If a fuse is blown, it is likely that the power supply module which was in use has an internal fault. See para 2–7 for replacement.

3 Measured on ac input cable disconnected from rear of chassis.

4 Measured on battery input filter C8 at inside rear of chassis. Remove top cover. Refer to figure 7–2.

5 Measured on battery terminals of main cable disconnected from rear panel J2, pins A and B or H (fig. 2–1).

6 With short on reg B+ distribution line in some external module, power supply goes into "Overcurrent protection" mode and will remain there indefinitely until short is cleared and regulator is reset by turning power off for ap-

proximately 20 seconds, then turning power on. Disconnect modules, one at a time, with power off at least 20 seconds, until the short is cleared and reg B+ returns to normal. Replace the indicated module. If this fails, have GS check chassis wiring.

7 The receiver normally supplies a nominal 300-ma trickle charge to a low battery. If a good, but discharged battery is not recharged, a fault probably exists in the power supply.

8 Forward to GS for repair.

Table 6-6. Rf Circuits Fault Analysis

NOTE

When fault diagnosis indicates a loss of sensitivity in the mixer-multiplier module as shown by abnormally low test point readings of the mixer output, and the LO injection into the mixer is normal as indicated by a normal MULT test point reading, and replacement of the mixer-multiplier module does not correct the condition, proceed as instructed below. See table 6-2 for normal test point readings.

WARNING

Observe instructions for removing power. Use extreme care when performing maintenance on a receiver with the top cover off and power applied.

Step	Procedure	Coaxial adapter required	Mixer out test point reading (note 2)	Further diagnosis required	Probable cause
1	Turn off power and bypass the antenna jack and the front panel coaxial link by connecting antenna or signal source directly to RECEIVER INPUT J11 at the front panel. Turn on power.	Type N to type BNC.	OK	None	Antenna jack J13, or cable from antenna jack, to coax jumper or coax jumper. Note 3.
			Low	Proceed to step 2.	
2	Turn off power and bypass antenna coupler A7 by connecting antenna or signal source directly to tunable filter input FL2J1. Turn on power.	Type N to UG 1464.	OK	None	Antenna coupler A7 or cable from front panel to antenna coupler. Note 3.
3	Turn off power and bypass the tunable filter by connecting antenna or signal source directly to mixer rf input. Turn on power.	Type N to UG 1465.	High (note 1).	None	Tunable filter FL2. Replace.
			Low	See note 4.	

NOTES

1 The tunable filter normally has approximately 5-db insertion loss at its center frequency. Bypassing the tunable filter in a normal receiver will result in a higher-than-normal reading at the mixer output test point.

2 MIXER OUT test point reading is compared with the value given in table 6-2 with signal source at 10 dbm and slightly off frequency, thereby disabling agc.

3 Forward to GS for cable or jack repair. DS should replace coaxial jumper or antenna coupler A7 if the fault lies there.

4 Forward to GS to check chassis wiring.

Table 6-7. Noise Limiter/Buffer Amplifier (A5) Output Fault Analysis

NOTE

When initial fault diagnosis indicates that a fault exists in the noise limiter involving the noise limiter through path signal, as shown by high MIXER OUT and low NOISE LIM test point readings, and replacement of the module does not correct the fault, the fault may be a shorted signal path in a component following the noise limiter. Disconnect the coaxial cable at the output of the noise limiter. If the noise limiter test point now indicates a reading equal to or somewhat higher than its normal value for agc disabled conditions, reconnect the coaxial cable and refer to the instructions below. See table 6-2 for normal test point readings.

WARNING

Observe instructions for removing power.

Step	Procedure	Test point readings	Further diagnosis required	Probable cause
1	Signal input at +10 dbm; all signal path connections made; signal generator frequency slightly off channel so that age is disabled.	MIXER OUT high; NOISE LIM low.	Proceed to step 2.	
2	Turn off power and disconnect signal cable input to if. amplifier A6 at FL1J1. Turn on power.	NOISE LIM indication increases. Unchanged	None Proceed to step 3.	If. amplifier A6. Replace.
3	Turn off power and disconnect crystal filter input cable. Turn on power.	NOISE LIM indication increases. Unchanged.	None Refer to GS to check chassis wiring.	Crystal filter. Replace FL1.

Table 6-8. If. Amplifier (A6) and Crystal Filter (FL1) Fault Analysis

Step	Procedure	Test point readings	Further diagnosis required	Probable cause
1	Signal input at +10 dbm; receiver in normal configuration.	Age (less than 9.0 volts) if low or normal.	Proceed to step 2.	
2	Turn off power and bypass the crystal filter with another crystal filter. Turn on power.	All normal Unchanged	None Proceed to step 3.	Crystal filter.
3	Replace if. amplifier A6 (para 6-13).	Normal Unchanged	None. Proceed to step 4.	
4	Replace module A5 (para 6-12)	Normal Unchanged	None. Have GS check chassis wiring.	

Section III. DS MAINTENANCE OF RECEIVER, RADIO AN/GRR-23 AND RECEIVER, RADIO AN/GRR-24

6-7. General

WARNING

Disconnect ac power from receiver before attempting to replace any of the modules.

Direct support repair of the receiver shall consist of replacing modules only. If troubleshooting procedures in the previous section call for any repair procedures not contained in this section, nor found in organizational maintenance instructions, refer the receiver to general support for repair.

6-8. Removal and Installation of Top Cover

WARNING

Disconnect ac power from receiver before removing top cover preparatory to replacing modules.

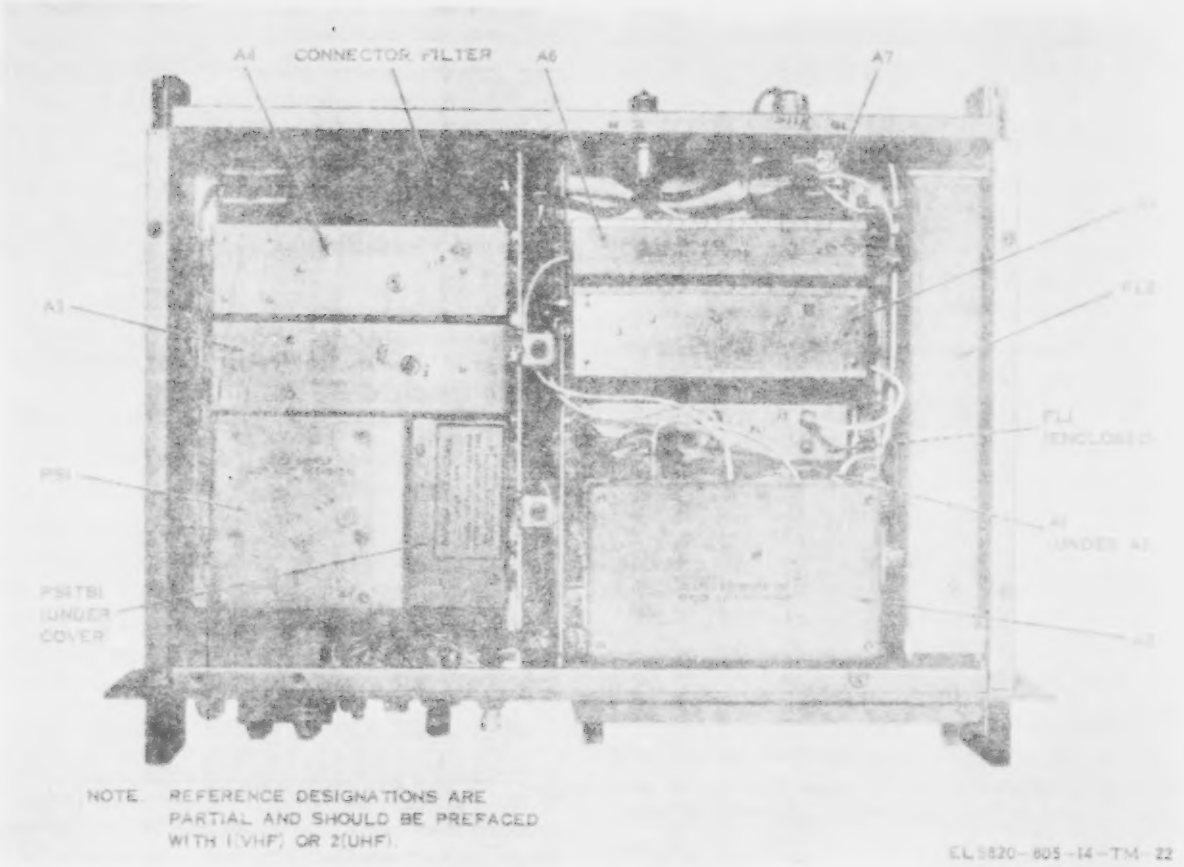


Figure 6-1. VHF/UHF receiver, top view, parts location and identification.

a. To remove top cover, unscrew six captive 6-32 Phillips-head screws and lift cover off.

b. To install top cover, put it in place and tighten six Phillips-head screws. Push down edges of cover to reduce rf interference.

6-9. Replacement of Modules A1 and A2 (fig. 6-1)

a. General. Module A2, the mixer-multiplier, is stacked on top of module A1, the local oscillator. Module A2 can be replaced without removing any other modules, but module A1 cannot be removed without removing module A2.

b. Removal of Module A2.

(1) Unscrew two 4-40 captive slot-head screws on J7 (number on equipment) and remove plug by pulling. Use care to avoid damaging surrounding wiring.

(2) Remove three coaxial cables at J1 on A2, J2 on FL2, and on the left side (front view) of A5. Use two 1/4-inch open-end wrenches for this. Do not apply excessive force.

(3) Unscrew the two 8-32 Phillips-head screws, one on each side of the module. Mixer-multiplier A2 can now be lifted out.

c. Installation of Module A2.

(1) Put mixer-multiplier A2 in place on top of oscillator A1 with controls to bottom front.

(2) Insert and tighten the two 8-32 Phillips-head screws which hold A2 to A1.

(3) Replace the three coaxial cables removed in *b*(2) above. The coaxial cable from the oscillator A1 fasten to J1 on A2, the coaxial cable out of the rear-center of A2 fastens to the buffer amplifier or noise limiter A5, and the coaxial cable out of the left (front view) rear of A2 leads to J2 on tunable filter FL2. Use two 1/4-inch open-end wrenches to make the connection. Do not apply excessive force.

(4) Replace A2P1 in J7 (number printed

on equipment) and tighten the two captive slot-head screws. Installation is complete. Check paragraph 6-18 for required tuning and alignment.

d. Removal of Module A1.

(1) Remove mixer-multiplier A2 by following instructions in *b* above.

(2) Remove A1P1 from J6 (number printed on equipment) by unscrewing the two slot-head 4-40 captive screws and pulling out.

(3) Loosen the four captive 8-32 Phillips-head screws which hold the module in place on the bottom of the chassis.

(4) The module can be removed by lifting out.

e. Installation of Module A1.

(1) Module A1, the local oscillator, should first be inserted in place on the floor of the chassis just behind the front panel access door.

(2) Tighten the four captive 8-32 Phillips-head screws which hold the module to the floor of the chassis.

(3) Insert A1P1 into J6 (number printed on equipment) and tighten the two 4-40 slot-head screws which hold the plug in the jack.

(4) Install mixer-multiplier module A2 by following the instructions in *c* above. Check tuning and alignment requirements in paragraph 6-18.

6-10. Replacement of Module A3
(fig. 6-1)

a. Removal of Module A3.

(1) Remove top cover (para 6-8), observing warning.

(2) Preamplifier/agc-squelch A3 is held to the chassis by one captive 6-32 Phillips-head screw at the left end of the module (front view). Loosen this screw.

(3) Slide the module to the left until the alignment pins clear the nylon bushings in the chassis divider wall.

(4) Lift directly upward.

b. Installation of Module A3.

(1) Put module in place in chassis, align pins and plug with holes and jack on chassis divider wall, and push module to right (front view).

(2) Align and tighten 6-32 Phillips-head screw on left of module.

(3) Module is installed. Check paragraph 6-18 for required alignment or tuning.

6-11. Replacement of Module A4
(fig. 6-1)

Audiofrequency amplifier A4 is located immediately behind preamplifier/af-agc squelch module A3 and is removed and installed using the same procedure as for A3. Refer to paragraph 6-10 and follow instructions for removal and installation, adapting to module A4.

6-12. Replacement of Module A5
(fig. 6-1)

a. General. Module A5 may be either the buffer amplifier or the optional electrical noise limiter. In either case, the removal and installation procedure is identical. However, alignment procedure is not the same; refer to paragraph 6-18.

b. Removal of Module A5.

(1) Remove top cover (para 6-8), observing warning. Disconnect the two coaxial cables attached to module A5, using two 1/4-inch open-end hex wrenches. The cable attached to the left-top of A5 from mixer-multiplier A2 is the input, while the cable attached to J2 on FL1 from A5 is the output. Do not apply excessive force.

(2) Unscrew the 8-32 captive Phillips-head screw which holds the module to the chassis floor.

(3) Pull to the right until the alignment pins clear the nylon bushings in the chassis divider wall and lift directly upward.

c. Installation of Module A5.

(1) Insert module in place by placing on chassis floor and aligning pins and plug with holes and jack on chassis divider wall.

(2) Connect coaxial cables removed above and tighten 8-32 Phillips-head screw which holds the module to the chassis floor.

(3) The module is installed. Check paragraph 6-18 for required alignment and tuning

6-13. Replacement of Module A6
(fig. 6-1)

a. Removal of Module A6.

(1) Remove top cover (para 6-8), observing warning.

(2) Using two 1/4-inch open-end hex wrenches, remove coaxial cable connections associated with if. amplifier module A6. The coaxial cable connected to the right side of A6 leads to J10 on the rear panel where the if. is available. The coaxial cable connected to J1 on FL1 from A6 is the input to the if. amplifier.

(3) Loosen the 8-32 captive Phillips-head screw on the right (front view) side of the module which holds it to the chassis floor.

(4) Remove by sliding to the right until the alignment pins clear the nylon bushings in the chassis divider wall. Then pull straight up.

b. Installation of Module A6.

(1) Put module A6 in place by inserting straight down, aligning the pins and jack with the holes and plug in the chassis divider wall.

(2) Align and tighten 8-32 captive Phillips-head screw on the right side of the module which holds the module to the chassis.

(3) Reconnect the coaxial cables removed in *a* above. Do not apply excessive force.

(4) Module A6 is installed. Refer to paragraph 6-18 for alignment and tuning requirements.

6-14. Replacement of Module A7
(fig. 6-1)

a. Removal of Module A7.

(1) Remove top cover (para 6-8), observing warning.

(2) Remove connection or shorting cap on A7J2 on rear panel.

(3) Remove large input coaxial cable from A7J1 on top of module. Connector is removed by loosening 1/4-inch hex nut.

(4) Remove coaxial output cable of A7 from J1 on tunable filter FL2. Use two 1/4-inch hex wrenches.

(5) Loosen and remove four 4-40 Phillips-head screws on rear panel which secure module A7 to chassis. Retain screws and washers for installation.

(6) Loosen the 8-32 captive Phillips-head screw at the right side of if. amplifier A6. This is to allow movement of A6 for additional room for removing A7.

(7) Pull module A7 forward out of rear panel hole and straight up out of chassis.

b. Installation of Module A7.

(1) If 8-32 captive Phillips-head screw at right side of if. amplifier A6 is not loose, loosen it.

(2) Insert module A7, the antenna coupler, into place with J2 through rear panel hole. It is necessary to push A6 forward slightly in order to get A7 in.

(3) Tighten the screw loosened in (1) above.

(4) Insert four 4-40 Phillips-head screws through holes in rear panel into appropriate holes in module A7. Use on flat washer with each screw. Tighten screws, thus securing module A7 to chassis rear panel.

(5) Install large input coaxial cable to the top of A7 using 1/4-inch open-end hex wrench.

(6) Install small output coaxial cable from A7 to the connector J1 on tunable filter FL2.

(7) Refer to paragraph 6-18 for required alignment or tuning.

6-15. Replacement of Crystal Filter FL1
(fig. 6-1)

a. Removal of FL1.

(1) Remove top cover (para 6-8), observing warning.

(2) Remove modules A1 and A2 by following instructions in paragraph 6-9*a*, *b*, and *d*.

(3) Remove coaxial cable from J2 and J1 of FL1, using two 1/4-inch open-end hex wrenches.

(4) Unscrew one 8-32 Phillips-head screw at right end of mounting bracket of FL1. Unscrew the four 6-32 Phillips-head screws on the flange of the mounting bracket. Retain all screws and washers for installation.

(5) Slide mounting bracket to right until the alignment pins on the left end of the module clear the nylon bushings in the chassis divider wall. Lift up to remove the mounting bracket from the chassis.

(6) On top of mounting bracket, remove two 3/16-inch hex nuts, releasing filter FL1. Retain nuts and washers.

b. Installation of FL1.

(1) Install filter FL1 inside mounting bracket, using 3/16-inch nuts, one lockwasher, and one large flat washer each. The coaxial connection marked IN on the filter should project through the hole in the mounting bracket marked J2. Similarly, the OUT connector should project through the J1 hole.

(2) Put mounting bracket in place on the floor of the chassis with the two alignment pins inserted through the holes on the chassis divider wall.

(3) Insert and tighten one 8–32 Phillips-head screw at right end of the mounting bracket. Use one flat washer and one lockwasher.

(4) Insert and tighten four 6–32 Phillips-head screws with one lockwasher and one flat washer each. These screws are located two on each flange of the mounting bracket.

(5) Reconnect the coaxial cables from module A5 to J2 on FL1 and from A6 to J1 on FL2.

(6) Install modules A1 and A2 by following instructions in paragraph 6–9*d* and *e*.

(7) Refer to paragraph 6–18 for alignment or tuning requirements.

6–16. Replacement of Tunable Filter FL2
(fig. 6–1)

a. Removal of FL2.

(1) Remove top cover (para 6–8), observing warning.

(2) Using two 1/4-inch open-end hex wrenches, remove small coaxial cables from J1 and J2 of FL2.

(3) Loosen the captive 8–32 Phillips-head screw which holds the tunable filter to the bottom of the chassis.

(4) Loosen the two 8–32 Phillips-head screws, on the outer side panel of the chassis, which secure the filter to the chassis. Retain screws and washers for installation.

(5) The tunable filter can now be lifted straight up and out.

b. Installation of FL2.

(1) Insert tunable filter FL2 in place in the chassis.

(2) Insert two 8–32 Phillips-head screws, with one flat washer each, through the right side panel of the chassis and into the appropriate holes of the tunable filter. Tighten.

(3) Tighten the captive 8–32 Phillips-head screw which holds the tunable filter to the chassis floor.

(4) Attach the two coaxial cables removed in *a* above. Use two 1/4-inch open-end hex wrenches. Do not apply excessive force. The cable from antenna coupler A7 attaches to J1 on FL2, and the cable from multiplier-mixer A2 attaches to J2.

(5) See paragraph 6–18 for alignment requirements.

6–17. Replacement of Module PS1
(fig. 6–1)

a. Removal of Module PS1.

(1) Remove top cover (para 6–8), observing warning.

(2) Loosen the two captive 8–32 Phillips-head screws on the left side of power supply PS1 which hold it to the chassis floor.

(3) Slide the module to the left until the alignment pins clear the nylon bushings on the chassis divider wall and lift straight up and out.

b. Installation of Module PS1.

(1) Place power supply PS1 in place in the chassis and push right so that alignment pins are inserted through holes on chassis divider wall.

(2) Tighten two captive 8–32 Phillips-head screws which secure the module to the chassis floor.

(3) Check to see that the input power transformer terminal board (PS1TB1) is correctly wired for the ac primary voltage. See paragraph 2–6*d* for instructions.

CAUTION

Failure to wire PS1TB1 correctly can result in damage to receiver.

(4) Refer to paragraph 6–18 for alignment and tuning requirements.

Section IV. ALIGNMENT AND PERFORMANCE TEST OF VHF AND UHF RECEIVERS

6-18. Alignment of VHF/UHF Receivers After Repair

a. All necessary alignment is included in the tuning procedures in paragraphs 2-10 (VHF), 2-11 (UHF), and 2-12 (VHF/UHF squelch) and in the performance test in table 6-9.

b. If it is necessary to replace any modules, perform the checks given in paragraph 2-8. If it is necessary to replace any of the following modules, perform tuning procedures in paragraph 2-10 (VHF) or 2-11 (UHF) and squelch adjustment in paragraph 2-12:

(1) A1, oscillator.

(2) A2, mixer-multiplier.

(3) A3, preamplifier, af/agc-squelch.

(4) A5, optional noise limiter.

(5) A7, antenna coupler.

(6) FL2, tunable filter.

c. If any modules are replaced, or if general support replaces any components or does any repairs, it is the responsibility of direct support to perform a performance test of the receiver. See paragraph 6-19 for performance test.

6-19. Performance Test

Tools and test equipment required are listed in paragraph 6-2. Procedure for performance test is found in table 6-9. Performance test should be performed as called for in paragraph 6-18 and also on a timely basis. Perform performance test of receiver monthly as a preventive maintenance check. If receiver fails to meet performance standards, refer to troubleshooting procedures in section II.

Table 6-9. Performance Test of VHF and UHF Receivers

NOTE

Test points are on J15 (fig. 3-3). Controls are illustrated in figures 3-1 and 3-2.

Step	Setting of test equipment	Point of test	Operation of equipment	Performance standard
1	Turn signal generator on		Turn receiver on.	
2	Set signal generator to same frequency receiver is set. Allow 30 minutes warmup for signal generator to stabilize.			
3	Connect multimeter, set on 10 vdc scale, between AGC and GROUND test points on receiver (J15, fig. 3-3).	AGC test point.	Remove coaxial jumper between RECEIVER INPUT and ANTENNA connectors (J11 and J12) on front panel of receiver.	
4	Connect signal generator to RECEIVER INPUT connector (J11, fig. 3-1).		Set receiver SQUELCH switch (S1) to OFF.	
5	Set signal generator to −97.5 dbm (3.0 μv) ±0.5 dbm, 30% modulation at 1 kHz ±10%. Carefully adjust signal generator frequency, using both coarse and fine frequency controls, for maximum agc voltage. *Note.* If signal generator has not stabilized sufficiently, and continues to drift in frequency, this step should be repeated at intervals to assure that signal generator is on frequency.			Maximum agc voltage.
6	Set multimeter on 300-millivolt ac scale and connect between if. and ground test points.	If. test point on J15.	If adjustment is necessary, adjust AGC ADJUST potentiometer on agc/squelch module. (AGC ADJUST is accessible through top cover of receiver.)	125 millivolts ac ±5. (This setting may be changed later)

Table 6-9. Performance Test of VHF and UHF Receivers - Continued

Step	Setting of Test Equipment	Point of Test	Operation of Equipment	Performance Standard
7	Set multimeter on 10 vdc scale and connect to AGC test point. Reduce signal generator power to — 120 dbm (0.224 μv) ± dbm.	AGC test point	.....	Age voltage drops to its quiescent value of +2.6 vdc to +3.2 vdc.
7.1	If voltage does not drop, adjust AGC ADJUST through top cover until AGC voltage just drops to 2.9 ± 0.3 volt.			
8	Set signal generator to −120 dbm (1.78 μv) ± 1 dbm.	ACG test point	.....	Age voltage is 5.0 volts or greater. 120 to 180 millivolts
9	Set signal generator to −97.5 dbm (3.0 μv) ±0.5 dbm, 30 percent ±1% modulation at 1 kHz ± 10%.			
10	Set voltmter to 3 vac scale and connect between MAIN AF test point and GROUND test point.	MAIN AF test point	Remove Receiver top cover. Adjust Compression Level (R41) on AGC/Squelch module maximum clockwise.	
			Adjust AUDIO MAIN ADJ control maximum clockwise. If Performance Standard is not met, adust AF Preamp Adj (R32) on AGC/Squelch module for 2.00 vc ±25 millivolts.	2.00 vac ±25 millivolts
10A	Set voltmeter to 3 vac scale and connect between MAIN AF test point and GROUND test point.	MAIN AF test point	Adjust AUDIO MAIN ADJ level control on front panel of receiver.	1.6 vac ±25 millivolts
10B	Set voltmetef to 3 vac scale and connect between MAIN AF test point and GROUND test point.	MAIN AF test point	Readjust AF Preamp Adj	2.00 vc ±25 millivolts.
10C	Set voltmeter to 3 vac scale and connect between MAIN AF test point and GROUND test point.	MAIN AF test point	Adjust Compression Level control (R41) on AGC module.	1.95 vac ±10 millivolts
10D	Increase signal generator percent modulation from 30% to 90%.	MAIN AF TEST point	.....	Test voltage shall remain within 1.75 to 2.45 volts.
11	Observe that signal generator is still set at −97.5 dbm (3.0 μv) ±0.5 dbm 30 percent ±1% modulation at 1 kHz ±10%.	.....	Adjust receiver AUDIO MAIN ADJ potentiometer (R2) for 1.0	Multimeter indicates 1.0 vac.
12	Set multimeter to 1 vac scale.			
13	Switch signal generator to CW mode (−97.5 dbm) (3.0 μv) ±0.5 dbm.	.....	.....	Multimeter drops to 0.5 vac or less.
14	Set signal generator at −97.5 dbm (3.0 mv) ±0.5 dbm 30 percent ±1% modulated at 1 kHz ±10%.			
15	Set multimeter to 3 vac scale.	.....	Adjust receiver AUDIO MAIN ADJ potentiometer (R2) for 1.0 vac.	Multimeter indicates 1.0 ±0.5 vac.
16	Connect earphones to AUDIO OUTPUT jack (J14).	PHONE jack	Adjust AUDIO PHONE ADJ potentiometer for comfortable listening level	
17	While maintaining modulation level at 30 percent, slowly adust power level of signal generator from −97.5 dbm (3.0 μv) ±0.5 dbm to +13 dbm (999 mv) ± 10mv.	.....	.....	Observe highest and lowest excursion of voltage on DB scale of meter. Highest and lowest reading should not differ more than 3 bd (in terms of voltage V min V max, should be 0.7 or greater).
	While changing power level of signal generator observe indications listed in Performance Standard column.			Tone in earphones should not exhibit excessive distortion.

Table 6-3. Performance Test of VHF and UHF Receivers—Continued

Step	Setting of Test Equipment	Point of Test	Operation of Equipment	Performance Standard
18	Set signal generator to −97.5 dbm (3.0 μV) ± 0.5 dbm modulated 30 percent ± 10 %.		Set receiver AUDIO SQUELCH ADJ potentiometer (R1) maximum counterclockwise.	
			Set receiver SQUELCH switch (S1) to ON.	Audio should remain fully available and unchanged in earphones (receiver should not be squelched).
19			Set receiver AUDIO SQUELCH ADJ potentiometer (R1) maximum clockwise.	Receiver squelched (quieted).
20	Raise signal generator power level to −73 dbm (50.1 μV) ± 0.5 dbm.			Receiver remains squelched.
21	Set signal generator to off, and disconnect from receiver.		Replace coaxial jumper between ANTENNA and RECEIVER INPUT connectors on front panel of receiver.	

CHAPTER 7

GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. GENERAL AND TROUBLESHOOTING

7-1. Scope of General Support Maintenance

a. General support personnel will not repair modules of the VHF or UHF receiver. Module repair will be performed at the depot category by the US Air Force.

b. General support will perform on site or in shop, troubleshooting and repair of receivers only after direct support personnel have performed all possible troubleshooting and repair procedures found in chapter 6. If receiver cannot be repaired by general support, the receiver should be forwarded to the US Air Force for depot repair.

7-2. Tools and Test Equipment

Tools and test equipment required by general support are the same as those required by direct support (para 6-2).

7-3. Troubleshooting Procedure

a. Upon receiving a receiver from direct support or being called in by direct support, general support personnel should carefully record the results of direct support troubleshooting and attempted repair. If direct support troubleshooting must be verified, this may be done on-site by following instructions in chapter 6. If a bench setup is required, refer to procedures in paragraph 7-4.

b. General support troubleshooting shall consist of continuity checks of chassis wiring and chassis components, and of substitution of connector filter (fig. 6-1). Using results of direct support troubleshooting, check resistance of wires and components associated with suspected faulty module. If no module is suspected, perform resistance check of all chassis components and wiring. Use table 7-1, a wiring list, and figure FO-8, an overall schematic diagram, to locate terminals and electrical location of components. Use figure 7-1 to locate components physically. Jacks are identified on equipment. Modules must be disconnected from chassis for resistance checks of chassis wiring. See section III of chapter 6 for removal and installation instructions for modules.

c. When a component is found to be faulty, refer to section II for replacement procedures.

Table 7-1. VHF/UHF Receiver Wire List

Wire number	From terminal connector	Pin	Conn lug	To terminal connector	Pin	Conn lug	Type	Gauge	Color	Est length Inches	Eighth	Notes	Remarks
1	J15	16	2	E4		4	E	22	0	9	0		
2	J15	14	2	J3	2	DF	E	22	7	11	4		
3	J15	13	2	J3	3	DF	E	22	2	11	6		
4	J15	12	2	J4	13	DF	E	22	4	13	4		
5	J15	11	2	J4	8	DF	E	22	9	13	6		
6	J15	10	2	J9	8	DF	Y	22	5	15	4	1	Shielded
7	J15	9	2	J6	5	DF	E	22	6	15	4		
8	J15	8	2	J7	7	DF	E	22	95	13	0		
9	J15	6	2	J6	6	DF	E	22	1	16	2		
10	J15	4	2	J7	11	DF	E	22	96	13	6		
11	J15	3	2	J8	5	DF	E	22	93	16	0		
12	J15	2	2	J4	7	DF	E	22	90	16	0		
13	J15	1	2	J5	8	DF	E	22	8	18	4		
14	J14	T	4	J5	13	DF	E	22	96	16	4		
15	J14	R	4	J5	12	DF	E	22	95	16	4		
16	S1	1	4	J4	15	DF	E	22	91	5	0		
17	S1	2	4	R1	1	2	E	22	9	4	0		
18	S1	3	4	J4	9	DF	E	22	3	15	0		
19	R1	2	4	J4	10	DF	E	22	7	14	4		
20	R1	3	2	J4	11	DF	E	22	8	14	4		
21	R3	1	2	R2	1	2	E	22	1	4	0		
22	R3	1	2	J4	5	DF	E	22	1	15	4		
23	R3	3	2	R2	3	2	E	20	0	4	9		
24	R3	3	2	E4		4	E	20	0	10	6		
25	R3	2	2	J5	7	DF	E	22	7	17	0		
26	R2	2	2	J5	5	DF	E	22	90	16	6		
27	J3	1	DF	E3		4	E	20	0	4	2		
28	J3	4	DF	J6	3	DF	E	22	2	9	0		
29	J3	6	DF	J7	3	DF	E	22	2	6	4		
30	J3	8	DF	J8	3	DF	E	20	2	8	4		
31	J3	9	DF	J9	3	DF	E	20	2	9	0		
32	J3	10	DF	J4	3	DF	E	20	2	8	4		
33	J3	11	DF	J5	3	DF	E	20	2	10	2		
34	J3	12	DF	J6	2	DF	E	22	7	8	6		
35	J4	1	DF	E3		4	E	20	0	4	0		
37	J4	6	DF	J5	15	DF	E	22	6	8	6		
38	J4	14	DF	E6		2	E	22	5	6	0		
39	J5	1	DF	E2		4	E	20	0	4	2		
40	J5	9	DF	C2	1	2S	E	22	4	11	2	2	
41	J5	11	DF	C3	1	2S	E	22	3	11	2	2	
42	J5	10	DF	C4	1	2S	E	22	9	11	2	2	
43	J7	1	DF	E7		4	E	20	0	7	4		
44	J7	5	DF	E6		2	E	22	5	4	0		
45	J6	1	DF	E7		4	E	20	0	3	0		
46	J8	1	DF	E7		4	E	20	0	7	4		
47	J9	9	DF	E6		2	E	22	5	10	0		

48	J9	1	DF	E5		4	E	20	0	5	0		
49	J9	5	DF	C5		2S	Y	22	6	10	0	3 & 2	Shielded
50	J9	7	DF	J4	12	DF	E	22	95	7	6		
53	C1	1	2S	E6		2	E	22	5	14	0	2	
54	C8	1	2S	XF3	1	4	E	22	6	23	6	2	
55	XF3	2	4	S2	3	4	E	22	7	9	4		
56	S2	7	4	J3	7	DF	E	22	6	18	0		
60	J3	5	DF	J6	4	DF	E	22	92	7	0		
61	C6	1	2S	XF1	1	4	R	20	8	22	4	}	
62	C7	1	2S	XF2	1	4	R	20	98			}	Twisted Pair
63	XF1	2	4	S2	1	4	R	20	1	11	0	}	
64	XF2	2	4	S2	2	4	R	20	91			}	Twisted Pair
65	S2	5	4	XDS1	1	4	R	20	8	9	2	}	
66	S2	6	4	XDS1	2	4	R	20	98			}	Twisted Pair
67	S2	5	4	J3	14	DF	R	20	8	8	4	}	
68	S2	6	4	J3	15	DF	R	20	98			}	Twisted Pair

NOTES—CODE IDENTIFICATION

"WIRE NUMBER" COLUMN: NUMBERS 36 51, 52, 57, 58, and 59 DELETED.

"CONN LUG" COLUMN: DF 502056-402 CONTACT, FEMALE
2 2/8" STRIP LENGTH
4 4/8" STRIP LENGTH

"TYPE" COLUMN: E 4590 WIRE
Y 4596 WIRE, SHIELDED AND JACKETED
R 517875 WIRE, TWISTED PAIR

"COLOR" COLUMN:
0 BLACK
1 BROWN
2 RED
3 ORANGE
4 YELLOW
5 GREEN
6 BLUE
7 VIOLET
8 GRAY
9 WHITE
10 BLACK
11 ETC. BROWN

"NOTES" COLUMN: 1 SOLDER SHIELDS OF WIRE 6 AT E5
2 S—DENOTES SLEEVING, INSULATION
3 SOLDER SHIELD OF WIRE 49 AT E1 AND E5

7-4. Bench Setup for Operational and Troubleshooting Tests

a. Connect J1 on rear panel to ac power source. Use ac cable supplied with the interface cable kit.

CAUTION

Check to insure that ac input transformer PS1TB1 is strapped correctly for the ac source voltage applied. See paragraph 2-6*d* and figure 2-6.

b. Remove coaxial jumper from RECEIVER INPUT and ANTENNA jacks on front panel.

c. Connect Signal Generator AN USM-44 to RECEIVER INPUT jack, using 50-ohm shielded cable with a male BNC connector on receiver end.

d. Turn on receiver and connect Multimeter ME-26( )/U between AGC test point and ground, both on inside front panel access door. Set multimeter on 10 vdc scale.

e. Turn signal generator on and set to same frequency as receiver operating frequency. Allow 30 minutes for signal generator to warm up and stabilize.

f. Set signal generator to −97.5 dbm (3.0 μv) ±0.5 dbm, 30% modulation at 1 kHz ±10%.

g. Fine adjust the signal generator for maximum agc indication on the multimeter.

h. Troubleshooting procedures in chapter 6 performance test in table 6-9, or simple operational check can be performed on receiver. To check operation, plug in 600-ohm headset or speaker into OUTPUT jack (J14) on front panel. A standard phone plug is required.

Section II. GS MAINTENANCE OF VHF AND UHF RECEIVERS

7-5. Replacement of Front Panel Chassis Components, General
(fig. 7-1)

WARNING

Before replacing any front panel attachments, disconnect ac power source from receiver.

Before attempting to remove any front panel attachments, remove power supply PS1 (para 6-17) to allow access to inside of front panel. After replacement of front panel attachment is completed, install PS1 in place. All front panel attachments are common components conventionally attached. After replacing any front panel attachment, perform an operational test. Use the test setup in paragraph 7-4 if bench setup is required. If receiver is installed in rack, with all connections made, monitor a broadcast on the receiver's operating frequency to verify that receiver is operational, when tuning or performance test is required.

7-6. Replacement of R1, R2, and R3
(fig. 7-1)

a. SQUELCH ADJ control R1, MAIN ADJ (audio) control R2, and PHONE ADJ control R3 are on the front panel. Unsolder and label leads at rear of potentiometer to be removed.

b. Remove R1 and R2 from the front panel by unscrewing the hex nut on the front panel and pulling to the rear.

c. Remove R3 in a similar manner. First the control knob must be removed by loosening two Allen screws which secure the knob to the shaft. The small hex nut can then be removed.

NOTE

In removing R1, R2, and R3, retain attachments for installation purposes.

d. Installation of R1, R2, R3 is achieved by reversing removal procedure. Have direct support perform tuneup (paras 2-10, 2-11, and 2-12) and performance test (table 6-9).

7-7. Replacement of XF1, XF2, XF3, and XDS1
(fig. 7-1)

a. Remove high voltage cover by unscrewing two Phillips-head screws which attach it to the chassis.

b. Unsolder and label leads and unsolder capacitor attached to fuse receptacle to be removed.

c. Unscrew hex nut on inside and pull fuse receptacle or lamp receptacle forward and out.

d. Installation is the reverse of removal.

7-8. Replacement of C5, C10, and C11

a. Capacitors C9, C10, and C11 are attached

respectively to fuse receptacles XF1, XF2, and CF3 and to ground.

b. Remove high voltage cover on left front corner of receiver. Unsolder both leads of the capacitor attached to receptacle and remove receptacle.

c. Installation is reverse of removal. Capacitors are nonelectrolytic. Replace high voltage cover.

7–9. Replacement of S1 and S2 (fig. 7–1)

Switches S1 and S2 are the SQUELCH ON–OFF (S1) and the POWER ON–OFF (S2) switches. To remove, unsolder and label leads on rear, remove hex nut from front, and pull to rear and out. Retain attaching hardware. Installation is the reverse of removal.

7–10. Replacement of J11 and J12 (fig. 7–1)

Jacks J11 and J12 are the RECEIVER INPUT and ANTENNA jacks on the front panel. Receptacles J11 and J12 are female BNC receptacles attached to the front panel with a 5/8-inch hex nut each. Removal and installation is conventional.

7–11. Replacement of J14 and E8 (fig. 7–1)

a. Removal of J14. J14 is the phone plug receptacle on the front panel audio output.

(1) Unsolder and label all leads on rear of J14.

(2) Lift flap cover on front of J14 and remove J14 from chassis by removing special 5/8-

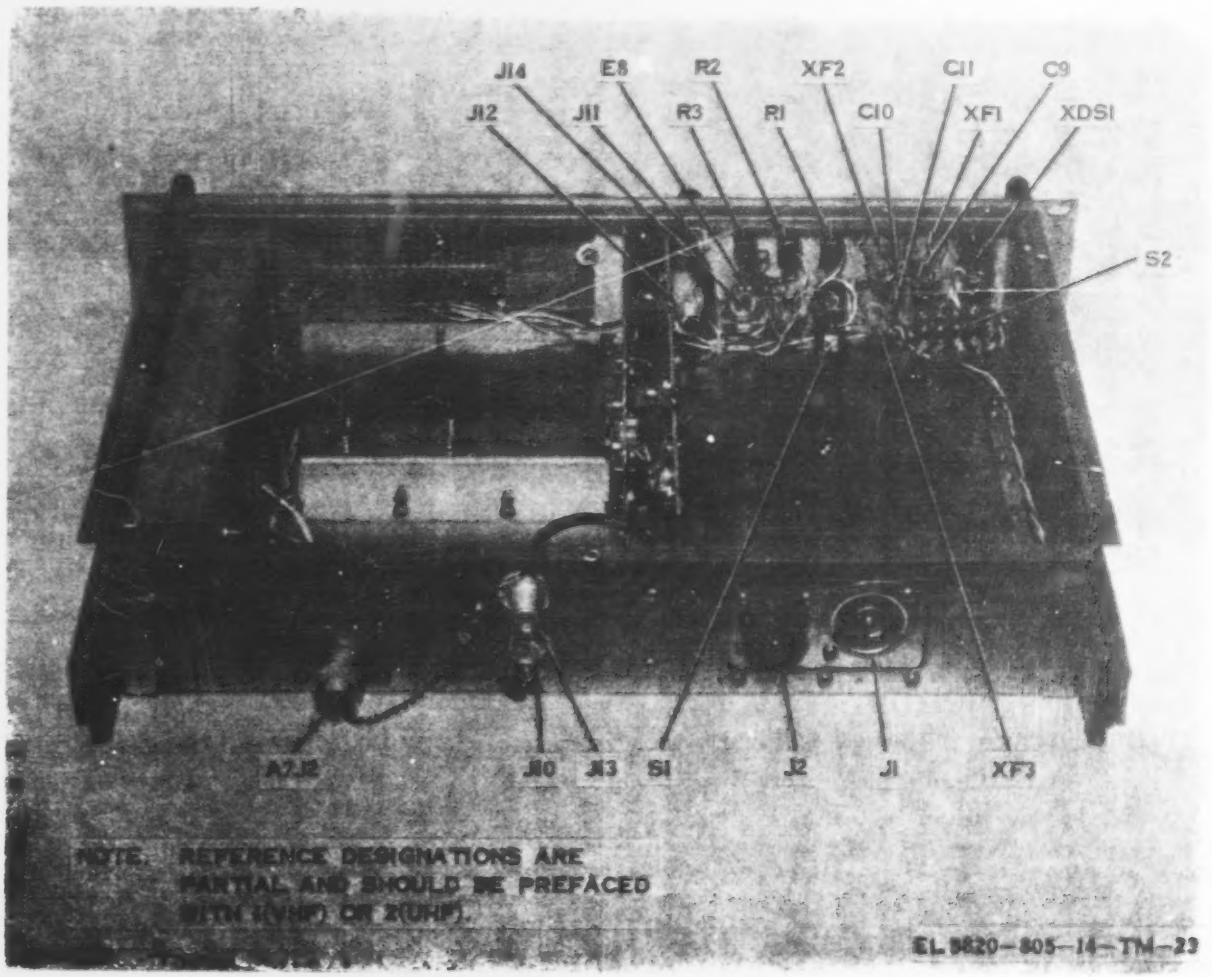


Figure 7–1. VHF/UHF receiver, rear top view, chassis component parts location and identification.

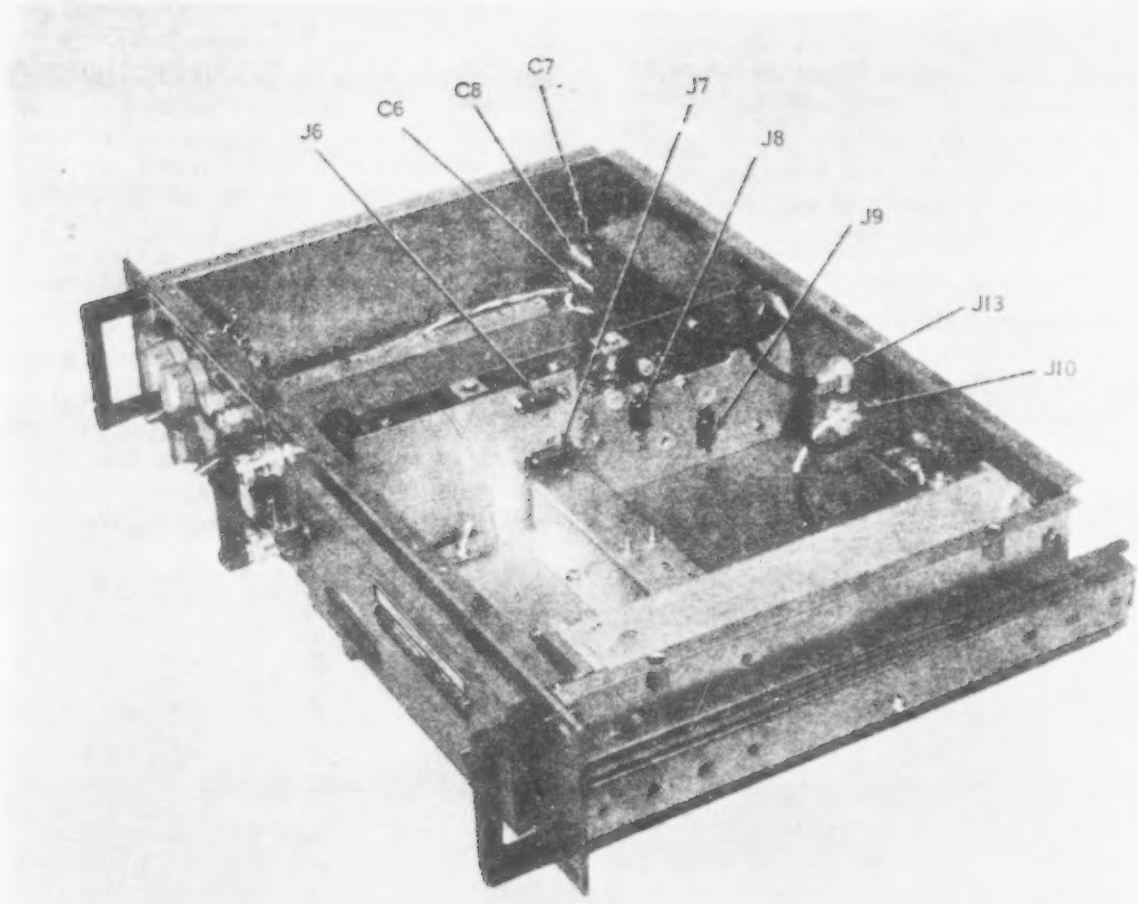


Figure 7-2. VHF/UHF receiver, chassis component parts on divider wall and rear panel, left oblique view.

inch hex nut on front, and removing flap cover assembly. Pull J14 toward rear and out.

(3) Unsolder and remove E8 and J14.

NOTE

E8 may be removed with J14 in place.

(4) Retain E8 and attaching hardware.

b. Installation of J14 and E8.

(1) Solder E8 between the two terminals on the rear of J14.

(2) Place rear portion of J14 on inside of chassis front panel through hole provided.

(3) Place flap cover assembly on outside front panel so that flap opens upward.

(4) Secure J14 to chassis, using special 5/8-inch hex nut removed above.

(5) Solder connecting wires on rear.

7-12. Replacement of Chassis Attachments on Divider Wall and Rear Panel, General (figs. 7-2 and 7-3)

WARNING

Before replacing any rear panel or di-

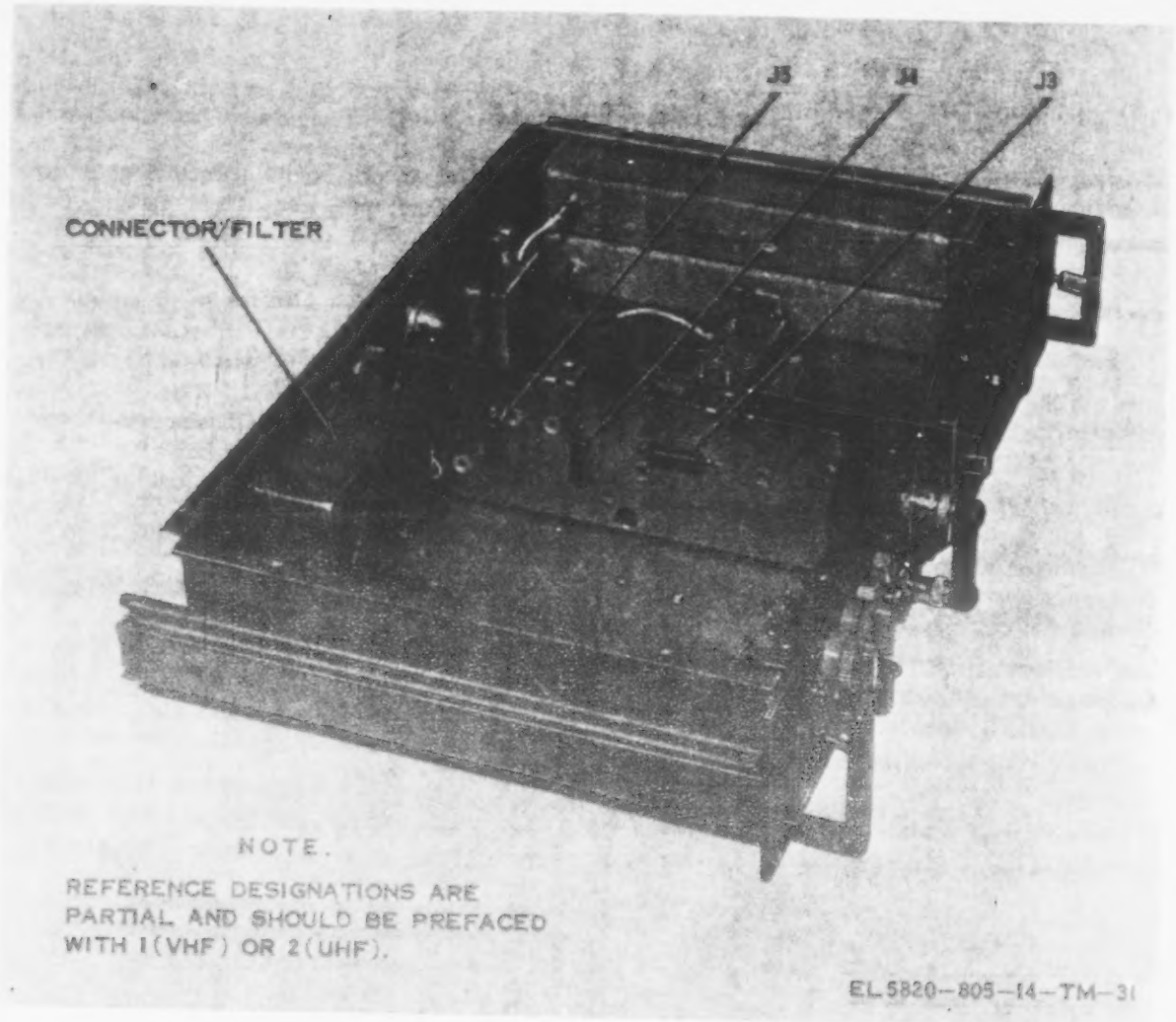


Figure 7-3. VHF/UHF receiver, chassis component parts on divider wall and rear panel, right oblique view.

vider wall chassis attachments, disconnect ac power source from receiver.

a. To gain access to some rear panel or divider wall attachments, it may be necessary to remove modules from the receiver. For instructions on removing module, see chapter 6, section III.

b. When any attachments are repaired or replaced, perform an operational check. If a bench test setup is required, refer to paragraph 7-4. Otherwise, check for complete rack installation and connections, and monitor the signal of a transmitter broadcasting on the receiver's operating frequency.

c. Perform performance test (table 6-9) of receiver, after repair of any components.

7-13. Replacement of Connector/Filter Assembly

(figs. 7-2 and 7-3)

a. General. The connector/filter assembly is replaced as a modular unit. It includes rear panel jacks J1 and J2; capacitors C1 through C8 through C14; and transient voltage protectors E1 and E2.

b. Removal of Connector Filter Assembly.

(1) Remove modules A3 and A4 (paras 6-10 and 6-11) to gain access to connector/filter.

(2) Unsolder leads from C6 through C8 and label.

(3) Unsolder leads from terminals on other side of connector/filter and label.

(4) Unscrew six Phillips-head screws on outside rear panel which hold connector/filter to chassis. Retain screws and rf screen shield and gasket.

(5) Remove connector/filter by pulling forward and up.

c. Installation of Connector/Filter Assembly.

(1) Put connector/filter assembly in place with C6, C7, and C8 to left (front view).

NOTE

Be sure to place rf screen shield at all points between outer circumference of connector/filter and chassis. Use gasket between rear face of connector/filter and chassis.

(2) Insert six Phillips-head screws with one lockwasher each through rear panel and into connector/filter. Tighten.

(3) Solder on wires removed in *b*(2) and (3) above.

(4) Replace modules A3 and A4 (paras 6–10 and 6–11).

7–14. Replacement of J10 and J13 (fig. 7–2)

Jacks J10 and J13 are respectively the if. output and antenna input jacks on the rear panel. Receptacle J10 is a female BNC receptacle and J13 is a female type N receptacle. Both may be removed from the chassis by removing the appropriate hex nut on the outside rear panel and pulling jack forward. They are installed by inserting through chassis hole and securing with hex nuts.

NOTE

Jack A7J2 (fig. 7–1) is replaced by replacing module A7 (para 6–14).

7–15. Replacement of Divider Wall Jacks (figs. 7–2 and 7–3)

a. Multipin female jacks J6, J7, J8, and J9 on figure 7–2; and J3, J4, and J5 on figure 7–3 are located on the chassis divider wall. They are removed from the wall by loosening two Phillips-head screws.

NOTE

Jacks J6 and J7 are held to the divider wall by two 3/8-inch hex nuts each and not by screws.

b. The jacks are replaced by tightening Phillips-head screws or 3/8-inch hex nuts removed in *a* above.

APPENDIX A

REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins Supply Manuals (Types 7, 8, and 9), Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	U.S. Army Equipment Index of Modification Work Orders.
SC 5180-91-CL-R13	Tool Kit, Electronic Equipment TK-101/G.
SC 5180-91-CL-S21	Tool Kit, Electronic Equipment TK-100/G.
TB 746-10	Field Instructions for Painting and Preserving Electronics Command Equipment.
TM 11-5820-805-24P	Organizational, Direct Support and General Support Repair Parts and Special Tools List for Receivers, Radio AN/GRR-23 and AN/GRR-24.
TM 11-6625-200-15	Operator's, Organizational, DS, GS, and Depot Maintenance: Multimeters ME-26A/U, ME-26B/U, ME-26C/U, and ME-26D/U.
TM 11-6625-203-12	Operator and Organizational Maintenance: Multimeter AN/URM-105, Including Multimeter ME-77/U.
TM 11-6625-320-12	Operator and Organizational Maintenance Manual: Voltmeter, Meter ME-30A/U and Voltmeters, Electronic ME-30B/U, ME-30C/U, and ME-30E/U.
TM 11-6625-508-10	Operator's Manual: Signal Generators AN/USM-44 and AN/USM-44A.
TM 11-6625-700-10	Operator's Manual: Digital Readout, Electronic Counter AN/USM-207.
TM 38-750	The Army Maintenance Management Systems (TAMMS).
TM 740-90-1	Administrative Storage of Equipment.
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).

APPENDIX B
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

B-1. General

This appendix provides a summary of the maintenance operations for AN/GRR-23 and -24. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

B-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean, preserve, drain, paint, or to replenish fuel/lubricants/hydraulic fluids or compressed air supplies.

d. Adjust. Maintain within prescribed limits by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment/system.

h. Replace. The act of substituting a serviceable like-type part, subassembly, model (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module/component/assembly, end item or system. This function does not include the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

j. Overhaul. That periodic maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (e.g., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipment/components.

B-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, ap-

propriate "worktime" figures will be shown for each category. The number of man-hours specified by the "worktime" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C—Operator/Crew
O—Organizational
F—Direct Support
H—General Support
D—Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

B-4. Tool and Test Equipment Requirements (Table 1)

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

SECTION II MAINTENANCE ALLOCATION CHART
FOR

1. GROUP NUMBER	2. COMPONENT ASSEMBLY	3. MAINTENANCE FUNCTION	4. MAINTENANCE CATEGORY					5. TOOLS AND EQUIPMENT
			C	O	F	H	D	
00	RADIO RECEIVING AN/URC1 AND AM-2057/U	Inspect Service Test Test Test Align Align Align Calibrate Repair Repair Repair Repair						

TABLE . TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
RADIO RECEIVERS AN/GRR-21 AND AN/GRR-25

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE CATEGORY	NOMENCLATURE	NATIONAL/NATO STOCK NUMBER	TOOL NUMBER
1	F,D	MULTIMETER ME-26C 1/U	6625-00-553-0142	
2	F,D	GENERATOR, SIGNAL AN/GSM-64C 1	6625-00-889-4210	
3	F,D	TOOL KIT, ELECTRONIC EQUIPMENT TK-100/G	5180-00-605-0079	
4	D	TOOL KIT, ELECTRONIC EQUIPMENT TK-101/G	5180-00-064-5178	
5	D	MULTIMETER AN/USM-105	6625-00-999-7465	
6	F	COUNTER, ELECTRONIC DIGITAL READOUT AN/USM-207	6605-00-311-6368	
7	F	VOLTMETER, ELECTRONIC ME-30F 1/U	6625-00-643-1670	

INDEX

	Paragraph	Page
Administrative storage	1-4	1-1
Agc-squelch, preamplifier (A3):		
Adjustment after repair	6-18	6-15
Function	5-15	5-8
Replacement	6-10	6-12
Air Force depot maintenance agreement	1-1c	1-1
Alignment after repair	6-18	6-15
Amplifier, buffer (A5):		
Function	5-11	5-6
Replacement	6-12	6-12
Amplifier, intermediate frequency (A6):		
Function	5-14	5-8
Replacement	6-13	6-12
Antenna connection:		
One receiver	2-6b	2-6
Two receivers	2-6c	2-6
Antenna coupler (A7):		
Adjustment after repair	6-18	6-15
Function:		
UHF (2A7)	5-5	5-2
VHF (1A7)	5-4	5-2
Replacement	6-14	6-13
Audiofrequency amplifier (A4):		
Function	5-16	5-10
Replacement	6-11	6-12
Bench setup for operational and troubleshooting tests	7-4	7-4
Block diagram explanation	5-1, 5-2	5-1
Buffer amplifier (A5):		
Function	5-11	5-6
Replacement	6-12	6-12
Substitution of noise limiter	1-7f	1-2
Cabling and wiring, external	2-6	2-4
Calling in general support	6-1b	6-1
Capacitors C5, C10, and C11, replacement	7-8	7-4
Characteristics, technical	1-11	1-3
Chassis components, replacement (*See* Replacement of chassis components.)		
Checking unpacked equipment	2-3	2-1
Circuit function:		
A1 oscillator	5-8	5-3
A3 preamplifier/agc-squelch	5-15	5-8
A4 audiofrequency amplifier	5-16	5-10
A5 buffer amplifier	5-11	5-6
A5 optional noise limiter	5-12	5-7
A6 intermediate frequency amplifier	5-14	5-8
FL1 crystal filter	5-13	5-8
General	5-3	5-2
PS1 power supply	5-17	5-10
1A2 VHF mixer-multiplier	5-9	5-3
1A7 VHF antenna coupler	5-4	5-2
1FL2 VHF tunable filter	5-6	5-2
2A2 UHF mixer-multiplier	5-10	5-5
2A7 UHF antenna coupler	5-5	5-2
2FL2 UHF tunable filter	5-7	5-2
Common names	1-9	1-2

	Paragraph	Page
Connections, external:		
Antenna connection:		
One receiver per antenna	2-6*b*	2-6
Two receivers	2-6*c*	2-6
Connector J2	2-6*a*	2-4
Power connection	2-6*d*	2-8
Connector/filter assembly, replacement	7-13	7-7
Controls and indicators	3-2	3-1
Coupler, antenna (A7):		
Adjustment after repair	6-18	6-15
Function:		
UHF (2A7)	5-5	5-2
VHF (1A7)	5-4	5-2
Replacement	6-14	6-13
Crystal filter, bandpass (FL1):		
Function	5-13	5-8
Replacement	6-15	6-13
Crystal oscillator (1A1):		
Adjustment after repair	6-18	6-15
Function	5-8	5-3
Replacement	6-9	6-11
Crystal (Y1):		
Determining frequency	2-7*c*	2-8
Installation	2-7*c*	2-8
Damage from improper settings of controls	3-1	3-1
Depot maintenance by Air Force	1-1*c*	1-1
Description of receiver	1-7	1-1
Designations, reference	1-12	1-4
Destruction of Army materiel to prevent enemy use	1-3	1-1
Differences between AN/GRR-23 and AN GRR-24	1-8	1-2
Dimensions, packed	2-2*b*	2-1
Dimensions, unpacked	1-9	1-2
Direct support maintenance:		
Adjustment after repair	6-18	6-15
Performance test	6-19	6-15
Repair:		
General	6-7	6-10
Removal of top cover	6-8	6-10
Replacement of modules:		
A1 crystal oscillator	6-9	6-11
A2 mixer-multiplier	6-9	6-11
A3 preamplifier/age-squelch	6-10	6-12
A4 audiofrequency amplifier	6-11	6-12
A5 buffer amplifier	6-12	6-12
A5 optional noise limiter	6-12	6-12
A6 intermediate frequency amplifier	6-13	6-12
A7 antenna coupler	6-14	6-13
FL1 crystal filter, bandpass	6-15	6-13
FL2 tunable filter	6-16	6-14
PS1 power supply	6-17	6-14
General	6-1	6-1
Tools and test equipment	6-2	6-1
Troubleshooting:		
Preliminary test	6-4	6-1
Procedures:		
Further troubleshooting if module replacement fails to correct fault	6-6	6-6
General	6-3	6-1
Isolation of fault to module using test points	6-5	6-2
Emergency operation:		
General	3-6	3-5
Power failure	3-8	3-6
Unavailability of crystal Y1	3-7	3-5
Errors in manual, reporting	1-5	1-1
External inputs at connector J2	2-6*a*	2-4

	Paragraph	Page
Filter, crystal, bandpass (FL1):		
Function	5-13	5-8
Replacement	6-15	6-13
Filter, tunable (FL2):		
Adjustment after repair	6-18	6-15
Function:		
UHF (2FL2)	5-7	5-2
VHF (1FL2)	5-6	5-2
Replacement	6-16	6-14
Forms and records, maintenance	1-2	1-1
Front panel components, replacement at general support (*See* Replacement of chassis components, general support).		
Front panel attachments, replacement and tightening	4-10	4-4
Function of circuits (*See* circuit function.)		
Fuses and lamps, installation	2-7*a*,*b*	2-8
General support maintenance:		
Replacement of chassis components:		
Front panel:		
General	7-5	7-4
Procedures:		
C5, C10, and C11	7-8	7-4
J11 and J12	7-10	7-5
J14 and E8	7-11	7-5
R1, R2, and R3	7-6	7-4
S1 and S2	7-9	7-5
XF1, XF2, XF3, and XDS1	7-7	7-4
Rear panel and divider wall:		
General	7-12	7-6
Procedures:		
Connector/filter assembly	7-13	7-7
Divider wall jacks	7-15	7-8
J10 and J13	7-14	7-8
Scope of general support maintenance	7-1	7-1
Tools and test equipment	7-2	7-1
Troubleshooting:		
Bench setup	7-4	7-4
General	7-3	7-1
General support, when to call in	6-1*b*	6-1
Improper settings of controls, damage	3-1	3-1
Indicators and controls	3-2	3-1
Installation:		
Cable and wiring connections	2-6	2-4
In rack	2-5	2-3
Planning	2-4*d*	2-3
Plug-in items:		
Crystal (Y1)	2-7*c*	2-8
Fuses	2-7*a*	2-8
Lamps	2-7*b*	2-8
Scope and responsibility	2-4*a*	2-1
Tools	2-4*b*	2-1
Intermediate frequency amplifier (A6):		
Function	5-14	5-8
Replacement	6-13	6-12
Items comprising an operable equipment	1-9	1-2
Unavailability of crystal Y1	3-7	3-5
Jack J14, replacement	7-11	7-5
Jacks J10 and J13, replacement	7-14	7-8
Jacks on chassis divider wall, replacement	7-15	7-8
Lubrication	4-4	4-1
Maintenance:		
Depot, Air Force agreement	1-1*c*	1-1
Direct support	6-1—6-19	6-1

	Paragraph	Page
General support	7-1—7-15	7-1
Operator	4-1*b*	4-1
Organizational	4-1—4-10	4-1
Maintenance forms and records	1-2	1-1
Manual:		
Reporting of errors	1-5	1-1
Scope	1-1*a*	1-1
Mixer multiplier (A2):		
Adjustment after repair	6-18	6-15
Function:		
UHF (2A2)	5-10	5-5
VHF (1A2)	5-9	5-3
Replacement	6-9	6-11
Noise limiter, optional (A5):		
Adjustment after repair	6-18	6-15
Function	5-12	5-7
Replacement	6-12	6-12
Substitution for buffer amplifier	1-7*f*	1-2
Operating instructions:		
Controls and indicators	3-2	3-1
Damage from improper settings	3-1	3-1
Unusual conditions:		
General	3-6	3-5
Power failure	3-8	3-6
Unavailability of crystal Y1	3-7	3-5
Unusual conditions:		
Shutdown	3-5	3-5
Starting	3-3	3-5
Operator maintenance duties	1-1	1-1,
	4-1*b*	4-1
Optional noise limiter (A5):		
Adjustment after repair	6-18	6-15
Function	5-12	5-7
Replacement	6-12	6-12
Organizational maintenance:		
Lubrication	4-4	4-1
Preventive maintenance:		
General	4-5	4-1
Instructions	4-6	4-1
Repainting and refinishing	4-3	4-1
Repair of rear panel connections	4-11	4-4
Replacement and tightening of front panel attachments	4-10	4-4
Scope of maintenance	4-1	4-1
Test points checks	4-9	4-4
Tools and test equipment	4-2	4-1
Troubleshooting:		
General	4-7	4-3
Instructions	4-8	4-3
Oscillator, crystal (A1):		
Adjustment after repair	6-18	6-15
Function	5-8	5-3
Replacement	6-9	6-11
Packed dimensions	2-2*b*	2-1
Performance test	6-19	6-15
Periodic maintenance, direct support	6-1*c*	6-1
Plug-in items, installation	2-7	2-8
Power connection	2-6*d*	2-8
Power failure, operation	3-8	3-6
Power supply (PS1):		
Function	5-17	5-10
Replacement	6-16	6-14
Preamplifier/age-squelch (A3):		
Adjustment after repair	6-18	6-15
Function	5-15	5-8

	Paragraph	Page
Replacement	6-10	6-12
Preliminary checks	2-8	2-9
Preventive maintenance:		
General	4-5	4-1
Instructions	4-6	4-1
Purpose and use of receiver	1-6	1-1
Rack installation	2-5	2-3
Rear panel connections, repair	4-11	4-4
Receiver:		
Alignment after repair	6-18	6-15
Block diagram explanation	5-2	5-1
Circuit functions	5-3—5-17	5-2
Common names	1-9	1-2
Description	1-7	1-1
Differences between AN/GRR-23 and AN GRR-24	1-8	1-2
Direct support maintenance	6-1—6-19	6-1
General support maintenance	7-1—7-15	7-1
Installation	2-4—2-7	2-1
Operating instructions	3-1—3-8	3-1
Operator maintenance	1-1*b*, 4-1*b*	1-1, 4-1
Organizational maintenance	4-1—4-10	4-1
Performance test	6-19	6-15
Preliminary checks	2-8	2-9
Purpose and use	1-6	1-1
Reference designations	1-12	1-4
Running spares	1-10	1-3
Site and shelter requirements	2-1	2-1
Technical characteristics	1-12	1-4
Tuneup	2-9—2-12	2-9
Unpacking:		
Checking unpacked equipment	2-3	2-1
Description of packing	2-2*a*	2-1
Dimensions	2-2*b*	2-1
Receptacles XF1, XF2, XF3, and XDS1, replacement	7-7	7-4
Reference designations	1-12	1-4
Removal of top cover	6-8	6-10
Repainting and refinishing	4-3	4-1
Repair parts	4-1*d*	4-1
Replacement and tightening of front panel attachments	4-10	4-4
Replacement of chassis components, general support:		
Front panel:		
General	7-5	7-4
Procedures:		
C5, C10, and C11	7-8	7-4
J11 and J12	7-10	7-5
J14 and E8	7-11	7-5
R1, R2, and R3	7-6	7-4
S1 and S2	7-9	7-5
XF1, XF2, XF3, and XDS1	7-7	7-4
Rear panel and divider wall:		
General	7-12	7-6
Procedures:		
Connector filter assembly	7-13	7-7
Divider wall jacks	7-15	7-8
J10 and J13	7-14	7-8
Replacement of modules, direct support:		
A1 crystal oscillator	6-9	6-11
A2 mixer multiplier	6-9	6-11
A3 preamplifier/agc squelch	6-10	6-12
A4 audiofrequency amplifier	6-11	6-12
A5 buffer amplifier or noise limiter	6-12	6-12
A6 intermediate frequency amplifier	6-13	6-12
A7 antenna coupler	6-14	6-13

	Paragraph	Page
FL1 crystal filter, bandpass	6-15	6-13
FL2 tunable filter	6-16	6-14
PS1 power supply	6-17	6-14
Reporting of errors in manual	1-5	1-1
Running spares	1-10	1-3
Scope of general support maintenance	7-1	7-1
Scope of manual	1-1*a*	1-1
Site and shelter requirements	2-1	2-1
Spares, running	1-10	1-3
Storage, administrative	1-4	1-1
Switches S1 and A2, replacement	7-9	7-5
Technical characteristics	1-11	1-3
Test points on J15:		
Checking at organizational	4-9	4-4
Fault isolation at direct support	6-5	6-2
Normal indications	6-5	6-2
Tools and test equipment:		
Direct support	6-2	6-1
General support	7-2	7-1
Installation	2-4*b,c*	2-1
Organizational	4-2	4-1
Top cover, removal	6-8	6-10
Troubleshooting:		
Direct support:		
Further troubleshooting when module replacement does not correct fault	6-6	6-2
General procedure	6-3	6-1
Isolation of fault to module	6-5	6-2
Preliminary test	6-4	6-1
General support		
Bench setup	7-4	7-4
Procedure	7-3	7-1
Organizational:		
General	4-7	4-3
Instructions	4-8	4-3
Tubable filter (FL2):		
Adjustment after repair	6-18	6-15
Function:		
UHF (2FL2)	5-7	5-3
VHF (1FL2)	5-6	5-3
Replacement	6-16	6-14
Tuneup after repair	6-18	6-15
Tuning:		
General	2-9	2-3
Squelch control adjust	2-13	2-11
UHF receiver tuning	2-11	2-11
VHF receiver tuning	2-10	2-10
Unpacking:		
Checking	2-3	2-1
Description of packing	2-2*a*	2-1
Dimensions packed	2-2*b*	2-1
Use and purpose of receiver	1-6	1-1
Wholesale Interservice Support Agreement	1-1*c*	1-1
Wiring lists	7-3	7-1

By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

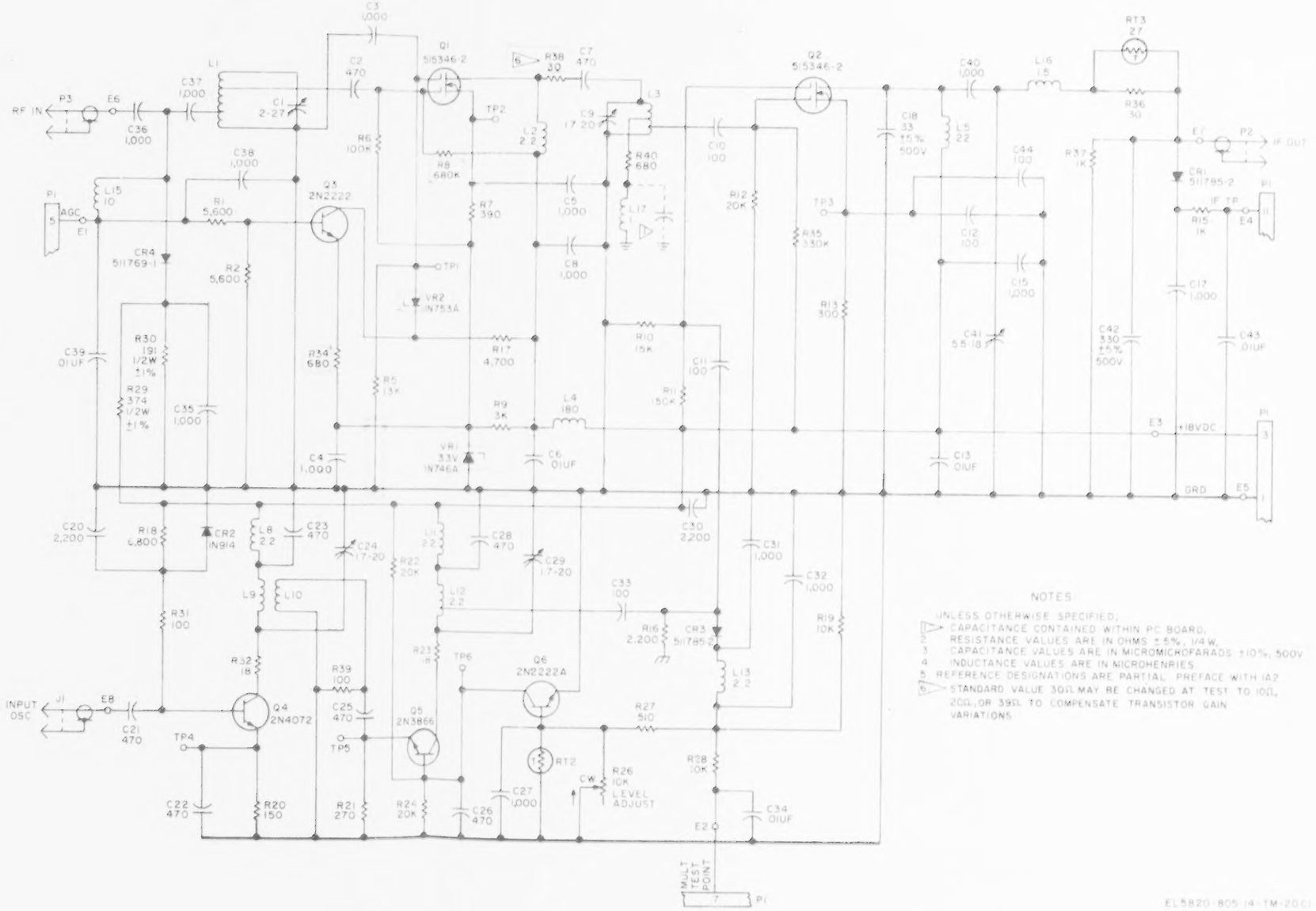
Official:

VERNE L. BOWERS
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-36A (qty rqr block No. 1207) Organizational maintenance requirements for all Geographical Areas.

☆U.S. GOVERNMENT PRINTING OFFICE: 1989 - 242-451/06032



NOTES

UNLESS OTHERWISE SPECIFIED,
1. CAPACITANCE CONTAINED WITHIN PC BOARD.
2. RESISTANCE VALUES ARE IN OHMS ±5%, 1/4 W.
3. CAPACITANCE VALUES ARE IN MICROMICROFARADS ±10%, 500V
4. INDUCTANCE VALUES ARE IN MICROHENRIES
5. REFERENCE DESIGNATIONS ARE PARTIAL. PREFACE WITH A2
6. STANDARD VALUE 30Ω MAY BE CHANGED AT TEST TO 10Ω, 20Ω, OR 39Ω TO COMPENSATE TRANSISTOR GAIN VARIATIONS.

EL5820-805-14-TM-20C1

Figure FO-1. VHF receiver mixer multiplier module (A2), schematic diagram.

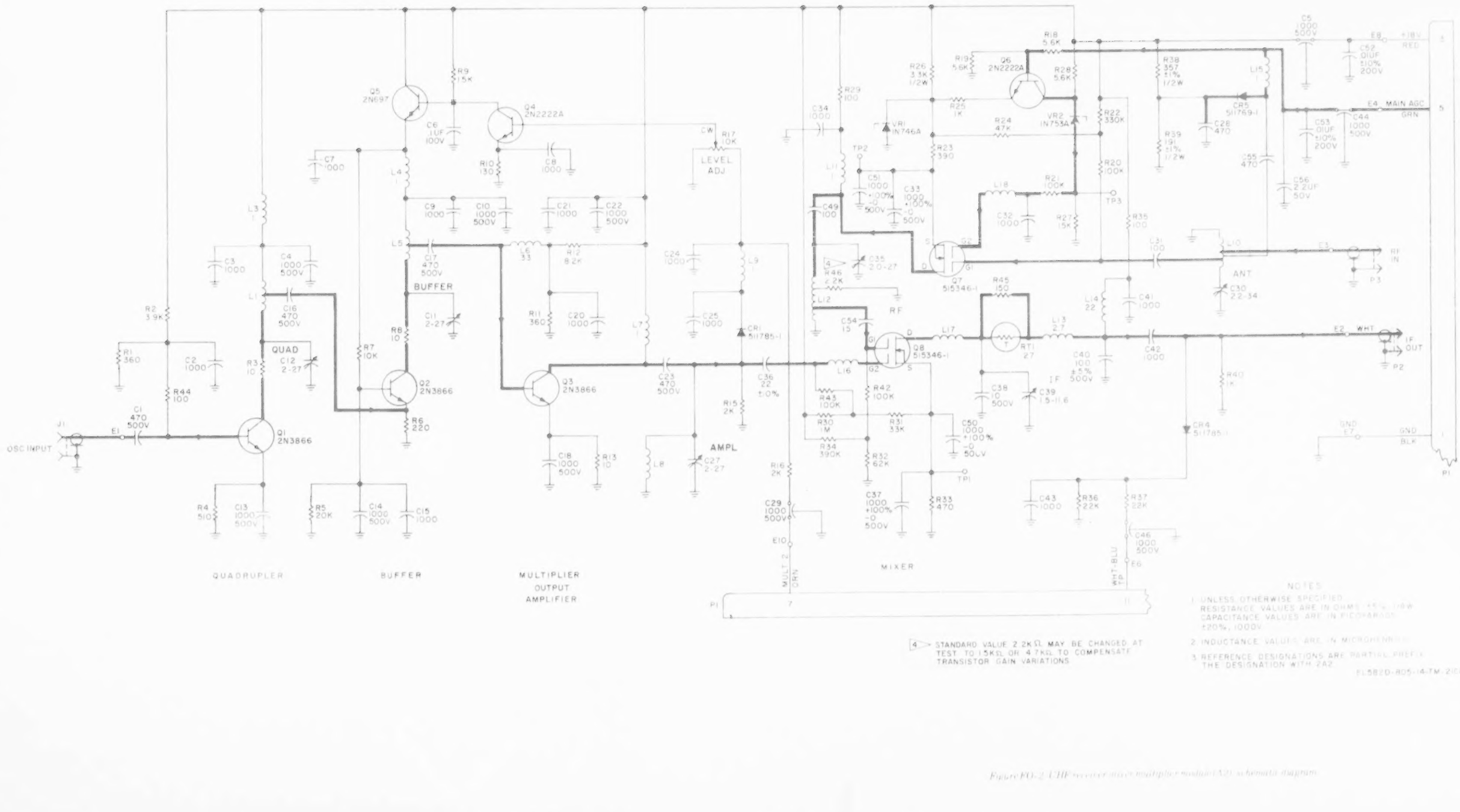


Figure FO-2. CHE receiver-mixer-multiplier module (A2), schematic diagram.

TEST POINT VOLTAGES

TP1	
TP2	12V ±1V
TP3	10V ±2V
TP4	2.5V ±.5V
TP5	0
TP6	1.5V ±.5V
TP7	2V ±.5V
TP8	1V ±.2V
TP9	10V ±2V
TP10	11V ±1V
TP11	5V ±.2V
TP12	1V ±.2V

Z3
- A - PULSE DETECTOR
- B - AGC CONTROL
- C - PULSE AMPLIFIER

NOTES:

UNLESS OTHERWISE SPECIFIED:

1. RESISTANCE VALUES ARE IN OHMS ±5%, 1/4W
2. CAPACITANCE VALUES ARE IN PICOFARADS ±10%, 1000 V
3. INDUCTANCE VALUES ARE IN MICROHENRIES ±10%
4. ALL VOLTAGE MEASUREMENTS TAKEN WITH A HIGH INPUT IMPEDANCE METER (HP427 OR EQUIVALENT).
5. ALL REFERENCE DESIGNATIONS ARE PARTIAL. PREFACE WITH 185 (VHF) OR 285 (UHF).

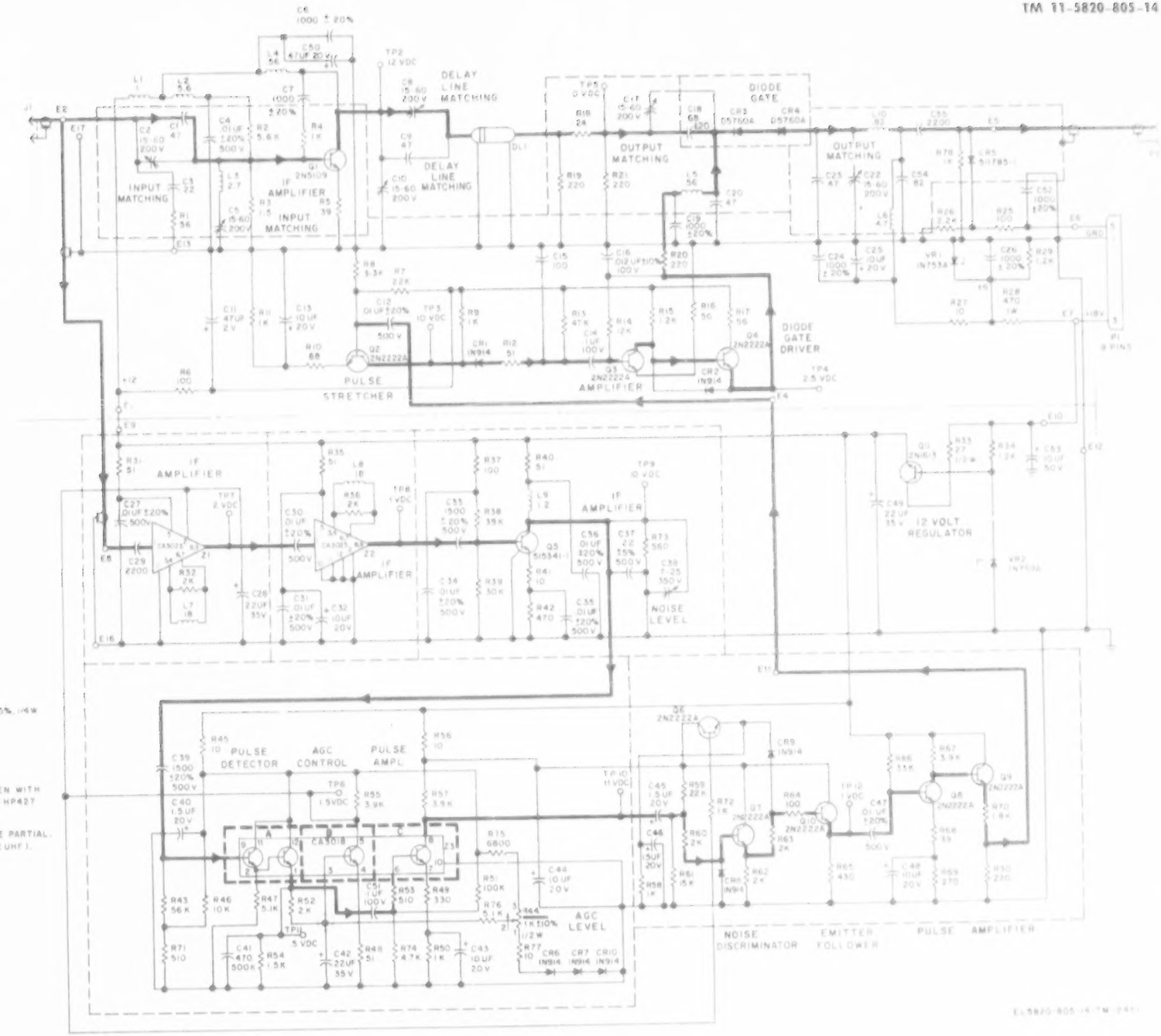
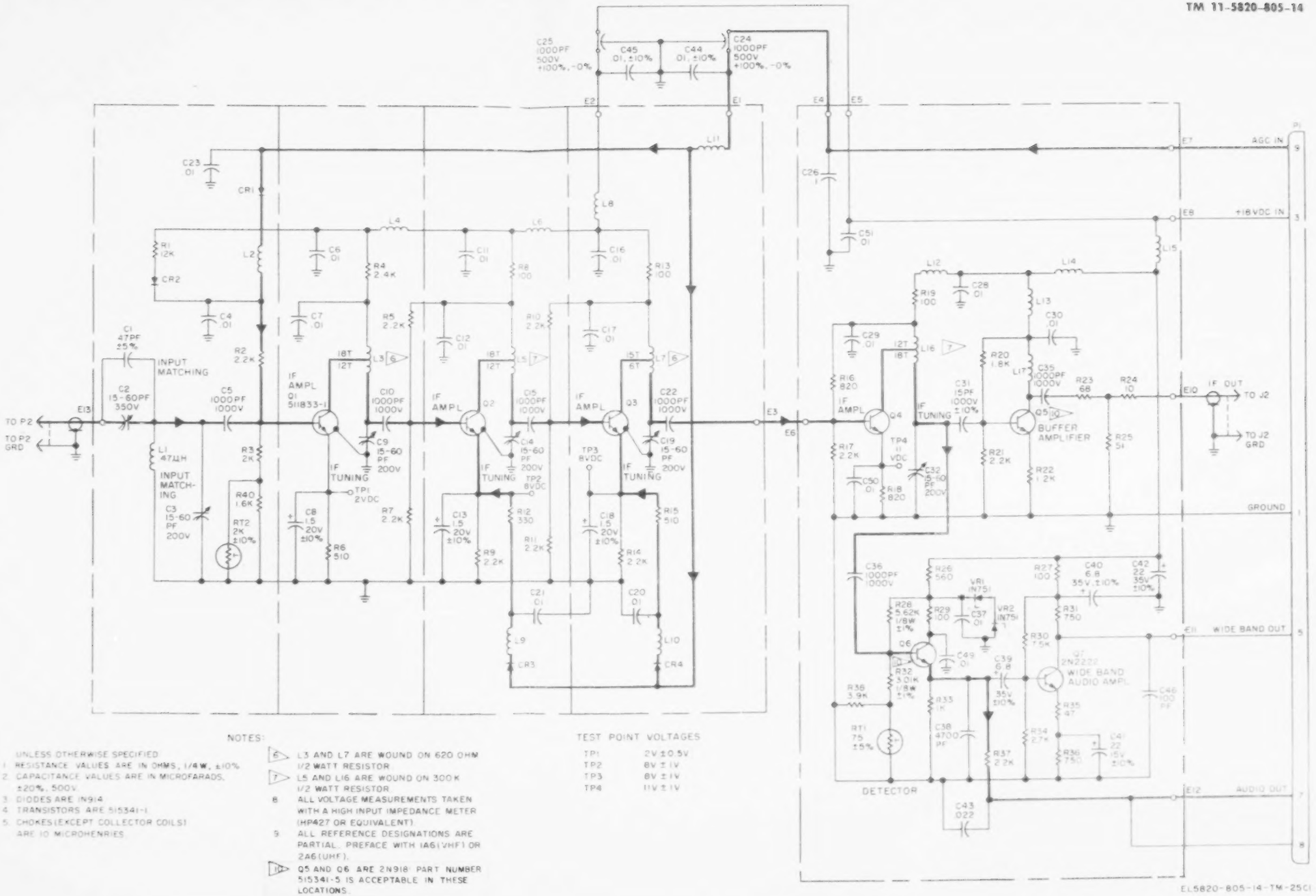


Figure FO-3. VHF/UHF receiver optional noise limiter/AGC schematic diagram.



NOTES:

UNLESS OTHERWISE SPECIFIED

1. RESISTANCE VALUES ARE IN OHMS, 1/4W, ±10%
2. CAPACITANCE VALUES ARE IN MICROFARADS, ±20%, 500V
3. DIODES ARE IN914
4. TRANSISTORS ARE 51534I-I
5. CHOKES (EXCEPT COLLECTOR COILS) ARE 10 MICROHENRIES
6. L3 AND L7 ARE WOUND ON 620 OHM 1/2 WATT RESISTOR
7. L5 AND L16 ARE WOUND ON 300K 1/2 WATT RESISTOR
8. ALL VOLTAGE MEASUREMENTS TAKEN WITH A HIGH INPUT IMPEDANCE METER (HP427 OR EQUIVALENT)
9. ALL REFERENCE DESIGNATIONS ARE PARTIAL. PREFACE WITH 1A6 (VHF) OR 2A6 (UHF).
10. Q5 AND Q6 ARE 2N918. PART NUMBER 51534I-5 IS ACCEPTABLE IN THESE LOCATIONS.

TEST POINT VOLTAGES

TP1	2V ±0.5V
TP2	8V ± 1V
TP3	8V ± 1V
TP4	11V ± 1V

Figure FO-4. VHF/UHF tuner, intermediate frequency amplifier and detector (A6), schematic diagram.

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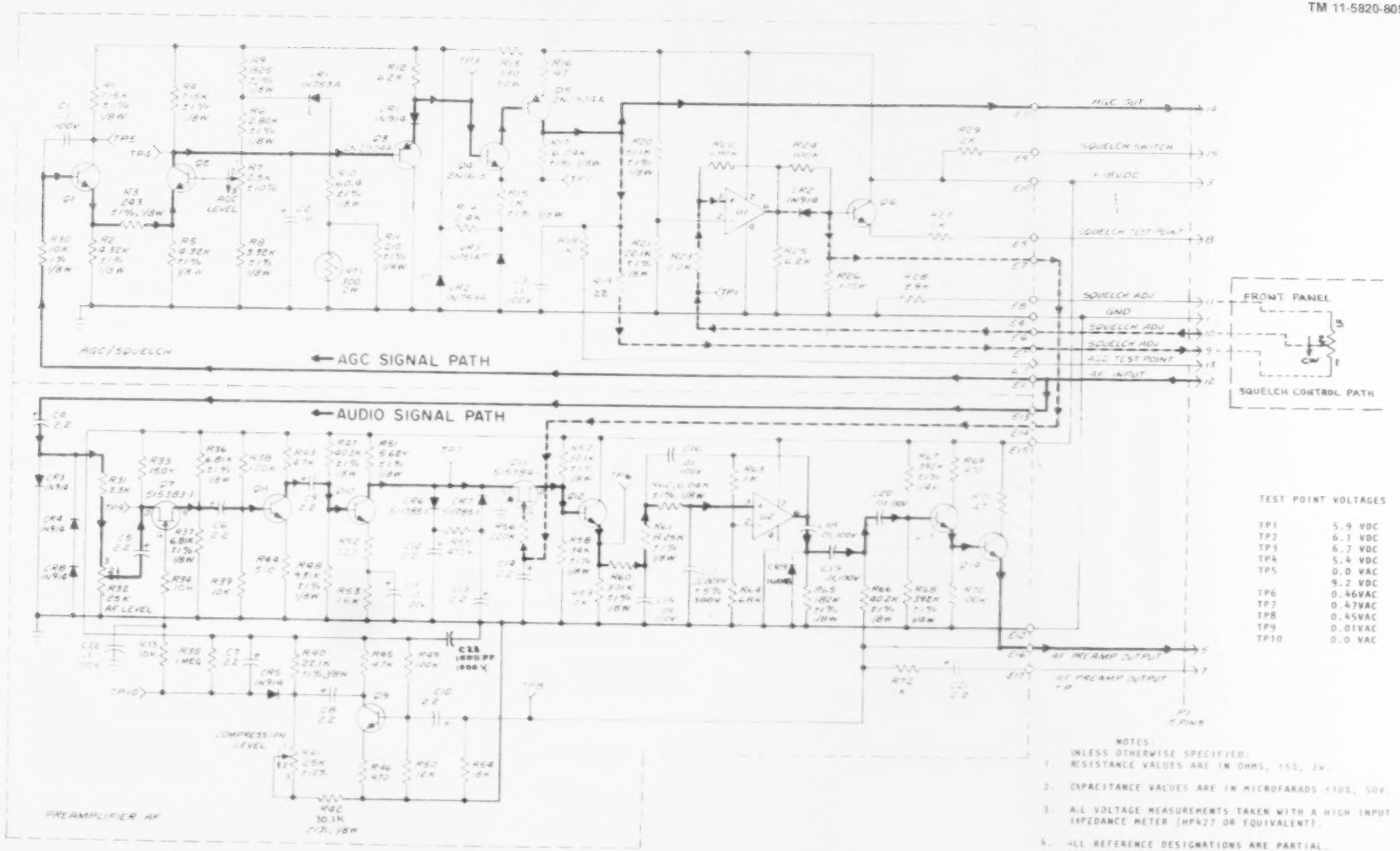


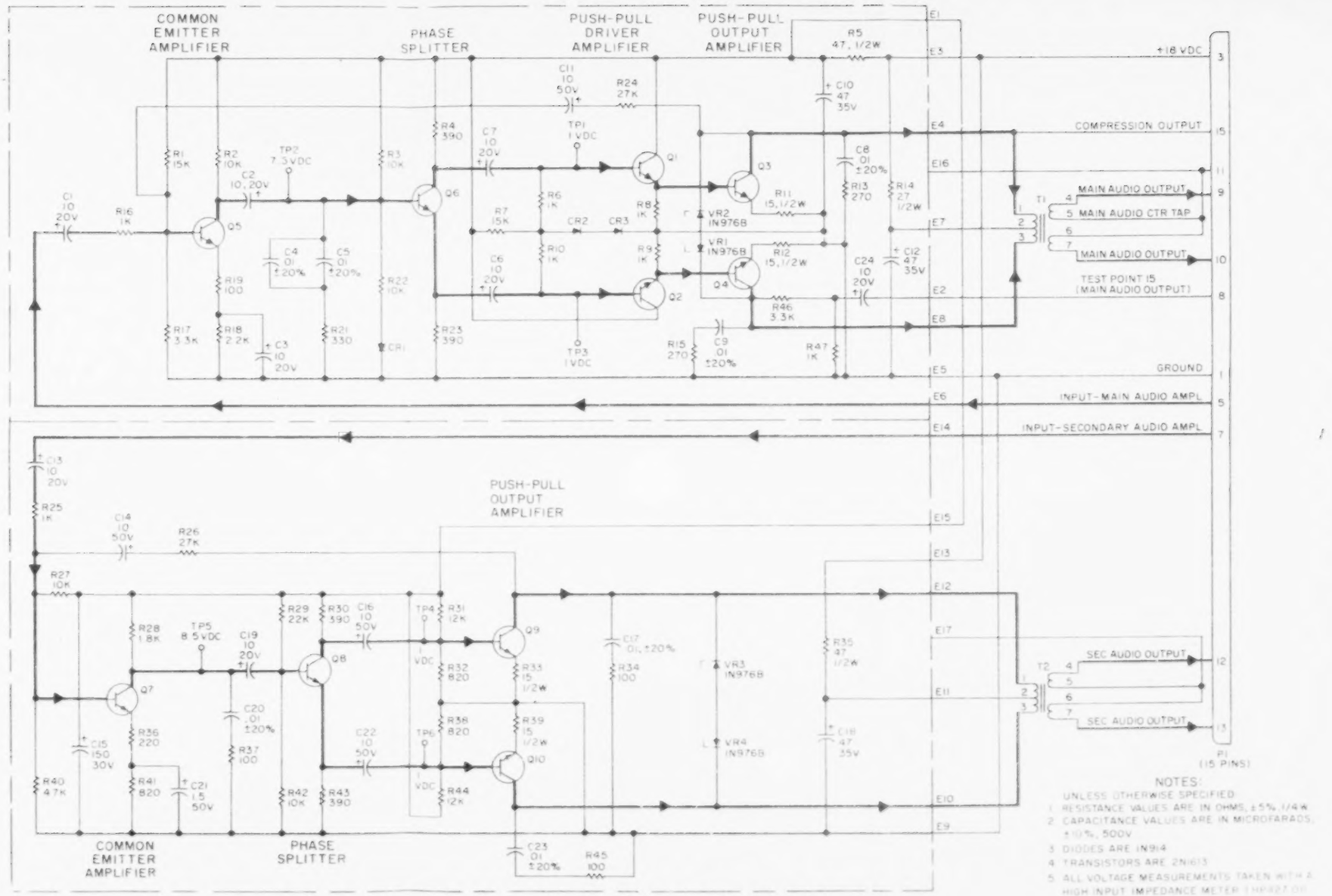
TEST POINT VOLTAGES

TP1	5.9 VDC
TP2	6.1 VDC
TP3	6.7 VDC
TP4	5.4 VDC
TP5	0.0 VAC
	9.2 VDC
TP6	0.46VAC
TP7	0.47VAC
TP8	0.45VAC
TP9	0.01VAC
TP10	0.0 VAC

NOTES:
UNLESS OTHERWISE SPECIFIED:
1. RESISTANCE VALUES ARE IN OHMS, ±5%, 1W.
2. CAPACITANCE VALUES ARE IN MICROFARADS ±10%, 50V.
3. ALL VOLTAGE MEASUREMENTS TAKEN WITH A HIGH INPUT IMPEDANCE METER (HP427 OR EQUIVALENT).
4. ALL REFERENCE DESIGNATIONS ARE PARTIAL. PREFACE WITH 1A3(VHF) OR 2A3(UHF).
5. ALL TRANSISTORS 2N2222A.
6. U1 AND U2 PART NO. 511854-1.

EL5820-805-14-TM-26,1C2

Figure FO-5. VHF/UHF receiver preamplifier/age squelch (A3), schematic diagram.



TEST POINT VOLTAGES

TP1	1V ±0.3V
TP2	7.5V ±0.5V
TP3	1V ±0.3V
TP4	1V ±0.2V
TP5	8.5V ± 1V
TP6	1V ±0.2V

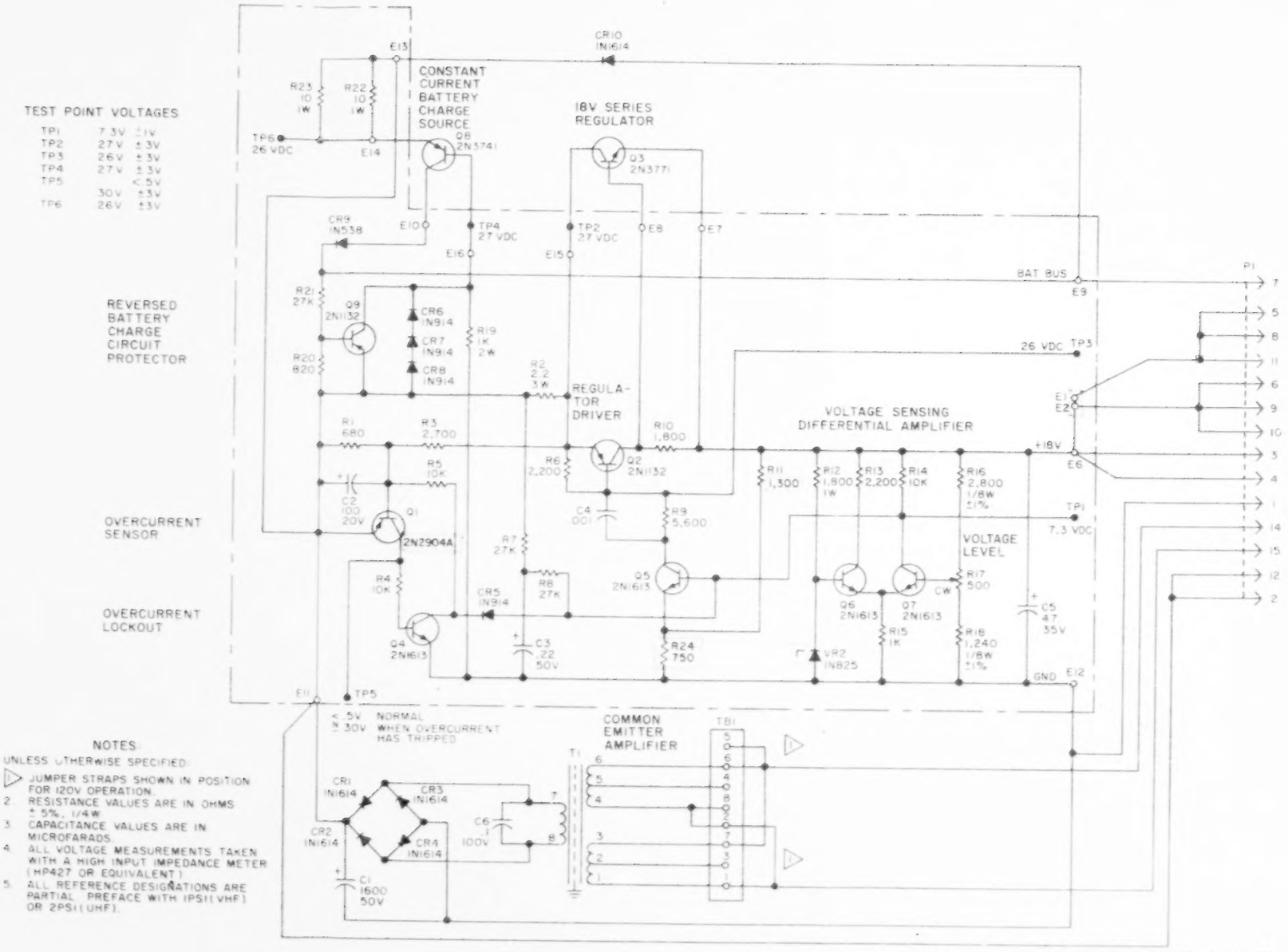
NOTES:
UNLESS OTHERWISE SPECIFIED
1. RESISTANCE VALUES ARE IN OHMS, ±5%, 1/4W
2. CAPACITANCE VALUES ARE IN MICROFARADS, ±10%, 50DV
3. DIODES ARE 1N914
4. TRANSISTORS ARE 2N1613
5. ALL VOLTAGE MEASUREMENTS TAKEN WITH A HIGH INPUT IMPEDANCE METER (HP427 OR EQUIVALENT)
6. ALL REFERENCE DESIGNATIONS ARE PARTIAL PREFACE WITH A4 (VHF) OR Z4 (UHF)

EL5820-805-14-TM-270

Figure FO-6. VHF/UHF receiver audioamplifier, schematic diagram.

TEST POINT VOLTAGES

TP1	7.3V	±1V
TP2	27V	±3V
TP3	26V	±3V
TP4	27V	±3V
TP5		<.5V
	30V	±3V
TP6	26V	±3V



NOTES:

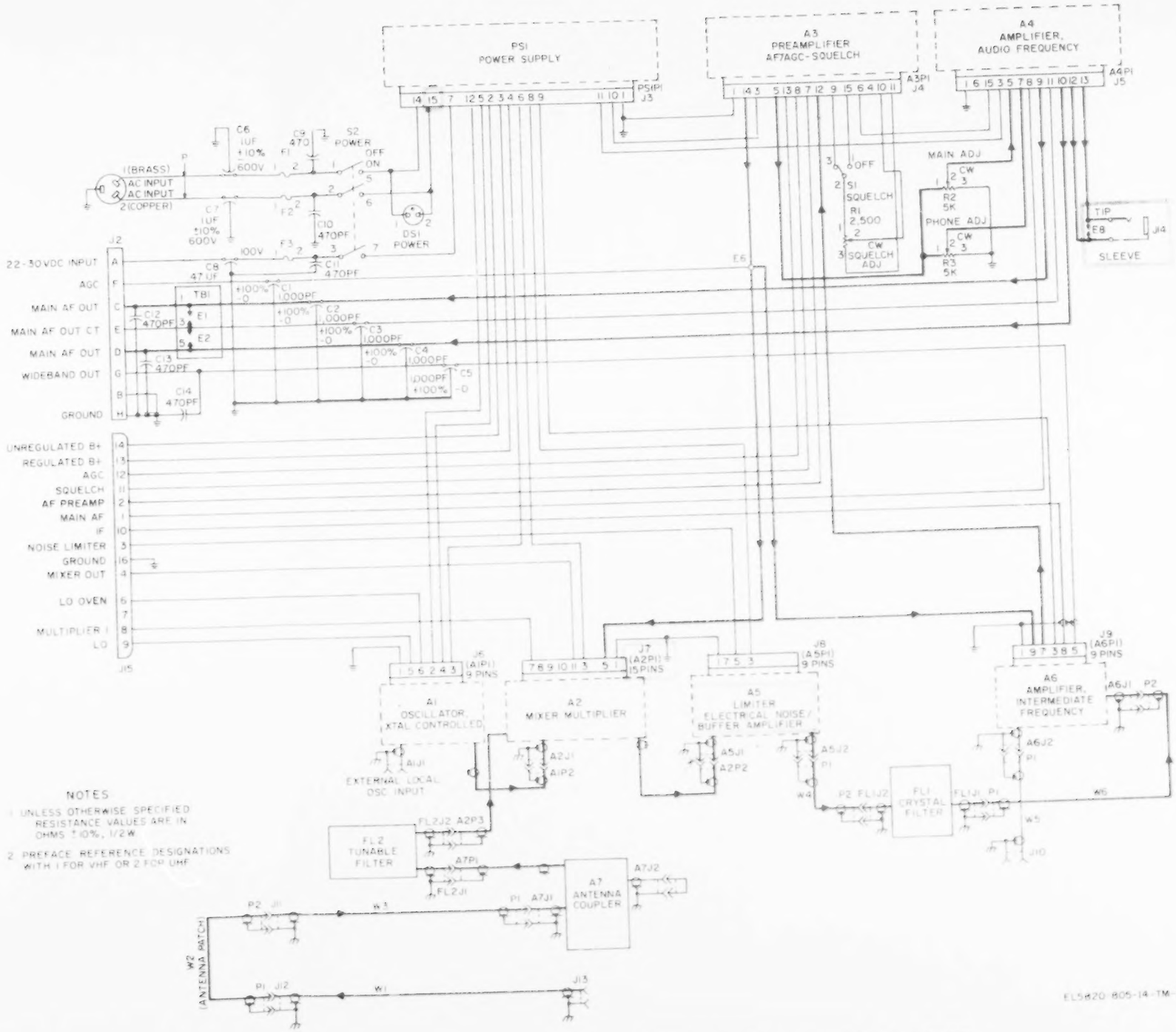
UNLESS OTHERWISE SPECIFIED:

▷ JUMPER STRAPS SHOWN IN POSITION FOR 120V OPERATION.

2. RESISTANCE VALUES ARE IN OHMS ± 5%, 1/4W.
3. CAPACITANCE VALUES ARE IN MICROFARADS.
4. ALL VOLTAGE MEASUREMENTS TAKEN WITH A HIGH INPUT IMPEDANCE METER (HP427 OR EQUIVALENT).
5. ALL REFERENCE DESIGNATIONS ARE PARTIAL. PREFACE WITH 1PS1 (VHF) OR 2PS1 (UHF).

EL5820-805-14-TM-280

Figure FO-7. VHF/UHF receiver power supply (PS1), schematic diagram.



NOTES

1. UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS ±10%, 1/2W.
2. PREFACE REFERENCE DESIGNATIONS WITH 1 FOR VHF OR 2 FOR UHF.

EL5820-805-14-TM-29CI

Figure FO-8. VHF/UHF receiver overall schematic diagram.